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THE BRITISH CIVIL SERVICE

THE centenary of the Trevelyan–Northcote report on the organization of the permanent Civil Service in Great Britain has prompted *The Political Quarterly* to devote almost the whole of its current issue to a discussion of the Civil Service in relation to its contemporary tasks and the needs of the British people. The major grounds of current criticism of the Civil Service are fairly and concisely recapitulated ; but the excess of criticism and its frequent extravagances are repudiated as firmly as they are by Mr. Herbert Morrison in his recent book and by Prof. K. C. Wheare in his commemorative lecture. The implications of the Crichel Down episode are carefully weighed, but the general verdict remains that the British Civil Service continues to be the best in the world.

Most of the articles contributed to this number pay some attention to the problems with which the scientist is most closely concerned ; for example, to the position and recruitment of the professional and scientific classes of the Civil Service, and the way in which expert advice should be given to the Government. Where such problems are not specifically mentioned, as in Sir John Woods's excellent article on Treasury control, the principles which guide current practice are clearly expounded. This article brings out, for example, some of the difficulties which are involved from the national point of view in the extension of the principle of quinquennial or block grants. Against the undoubted advantages from the point of view of planning research or educational policies, for example, which such a practice confers, there are certain drawbacks, which Sir John indicates. Simple or conclusive answers to such questions are rarely to be found, and this article is a valuable contribution to the understanding and goodwill on both sides on which effective public control of expenditure and the efficient use of resources—in money, materials or man-power—ultimately depend.

The essay of least interest to the man of science is that dealing with the Foreign and Commonwealth Services. It contains, apart from Prof. W. A. Robson's article, "Recent Trends in Public Administration", the only reference to the Colonial Service made in the symposium ; but this brief reference ignores entirely the problems of the Colonial Scientific Service and the implications both of political developments in the Colonies and of technical assistance and the Colombo Plan for that service. The bearing of Colonial Welfare and Development Acts and the large amount of research now being conducted by or on behalf of the Colonies are nowhere considered.

Of the more general articles, one by Mr. C. R. Attlee deals with the relations of Civil servants, Ministers, Parliament and the public much on the lines of Mr. Morrison's book, and comments on the advantage to the country of recruiting more scientists in the higher ranks of the Civil Service—and also the difficulty of doing so. It may be noted here that in considering recruitment, Mr. L. N. Helsby, First Civil Service Commissioner, expresses the view that

over the past nine years the Service has probably attracted at least a fair share of all scientific talent short of the highest class and also, recently, a reasonable share of recruits of exceptional ability. In spite of a serious shortage of engineers and surveyors, he does not believe that the Civil Service is seriously understaffed in comparison with the professions as a whole.

Mr. Helsby does not suggest that the final answers can yet be given to the question whether in the scientific and professional field the Civil Service is getting enough recruits and of the right kind; his present answers are conditioned by the fact that leading industrial firms themselves find difficulty in filling all their posts with exactly the type of person they desire. He maintains that the use made by the Civil Service Commission over the past nine years of the interview method in recruiting scientists has been developed sufficiently to secure the advantages of central recruitment and to meet the special circumstances of government scientific work. He does not, however, really touch on the recruitment to the administrative class, and especially at the highest levels, of scientists and technologists who show themselves possessed of the requisite administrative ability.

That problem, and also the further problem of the status and function of the specialist officer, are faced by Mr. H. R. C. Greaves. Reviewing the structure of the Civil Service, Mr. Greaves notes that, in spite of their present weakness as a group within the hierarchy, the considerable growth in numbers and significance of the professional and scientific officers in the Service, which has placed them near the sources of administrative decision and in close contact with the highest administrators, has given them opportunities of attaining such positions, which some at least have been able to seize. Mr. Greaves is not complaisant. He admits that a widening of the social basis of recruitment to the administrative class might also assist in the recruitment of those whose university training had been in science and not solely in the arts. He points out that the growth of attention to post-entry training and the recognition of Treasury responsibility in this matter give promise of the reduction of hierarchical rigidities, and one of his suggestions for improving the structure of the Civil Service and the correction of departmentalism is a more elastic, less rigid treatment of the hierarchical principle in recruitment, taking advantage particularly of the existence of the specialist or professional groups and of the newer administrators in nationalized services. With this, he suggests that much more could be done in training, in conjunction with the universities, by bringing together young officers from the Civil and other public services, and by the promotion of individuals who have distinguished themselves by creative research and training, to create a cadre of first-rate officers suited for all branches of public service. Thirdly, he suggests a lively and elastic promotion policy conducted by a body of officials, specially trained in the art of selection, ranging wide over all public employees, and concerned only to choose well to the public advantage, regardless of vested interest or departmental prejudice.

Mr. Greaves believes that for such measures to succeed it would be necessary to form a small 'machinery of government department', under the head of the Service and attached to the Prime Minister, which would provide a highly trained and carefully selected general staff for all branches of the Civil and public services. He argues that the experience and knowledge required can only be provided by a greatly strengthened body of officials, coupled with a clearer assertion of the powers of the head of the Service and a more definite assumption of authority by the Prime Minister. The suggestion is somewhat controversial, though Mr. Greaves claims support for it in an answer of Sir Warren Fisher to the Select Committee on National Expenditure in 1942, and it is not in conflict with Sir John Woods's remarks on Treasury control.

Sir John Woods is not concerned that the Treasury should be over-powerful; but he points out that the real question is the way in which control is exercised. Very little direct light is thrown on that question in this symposium. Sir Edward Bridges, viewing the reforms of 1854 in retrospect, tempers his conclusion that those reforms have stood the test of time with some observations on the qualities needed in the Civil servant which bear on this issue. He directs attention to the consequences of the infinitely wider range of duties with which the Civil Service to-day is charged, and the change in its composition compared with that of 1854. It now comprises, for example, very large scientific, professional and technical staffs, many of whom enter the Service after professional experience outside. Many problems are involved in ensuring that the relationships of these professional staffs with their colleagues in the other branches of the Service are on the best possible lines.

Such questions, Sir Edward remarks, are outside the scope of the report of 1854. It might be added that they are not entirely a matter for the Civil Service, and it is at least possible that professional bodies representing the whole of a profession, and not simply that part of the profession employed in the Civil Service, could give valuable assistance in working out solutions. That may be considered a special aspect of a second change which Sir Edward notes and which, so far as concerns the administrative, executive and clerical grades, he regards as the most significant. This is the increasing extent to which Civil servants are brought into contact with the public, through the larger concern of the State in economic affairs and industry, and through the work of the social service departments. Far more than before, the Civil servant is called upon to meet and to deal on behalf of the Minister with members of the public, either as individual citizens seeking information or redress about their benefits under social security, or with industrialists.

This calls for a wider range of qualities from the Civil servant and, because his task is changing and perhaps becoming rather more difficult than before,

Sir Edward remarks that even greater care must be taken in his recruitment and training. That suggestion is endorsed in the editorial notes and comments which introduce the whole symposium; incidentally these notes put the symposium in admirable perspective, both by a brief recapitulation of current criticism and by the bibliographical footnotes which include most of the serious contributions to the discussion over the past decade or more. Training is, in fact, regarded as still the weakest part of the Civil Service, in spite of improvements since 1946, and specifically the Crichel Down episode is regarded as representing a failure of training. *The Political Quarterly* believes that Civil servants would not behave thus if they received adequate training and insight in the proper manner of treating individual citizens at an early stage in their career.

The proliferation of organs and the complexity of the machinery is regarded as a contributory factor and adds substance to criticism which has fairly been made of the Government's decision to abolish the Ministry of Food and to transfer its residual functions to a Department the internal organization of which is already complex and of dubious efficiency, and which is not entirely met by the appointment of an independent committee to review the regional and local organization of the two Ministries.

One of the merits of *The Political Quarterly* symposium is that it turns attention to the more vital problems of a modern bureaucracy, and particularly to the need for an approach from outside as well as from within the Civil Service. Two major suggestions are made in this connexion. One is that the Treasury should appoint an advisory council on the Civil Service, consisting of leading Civil servants, business men, industrialists, university teachers of politics or public administration, and others with experience of public life. The council would have the function of advising the government on general or particular matters requiring investigation or consideration concerning not only the well-being of the Service, but also its improved relations with the public and the greater efficiency of its work. The second suggestion is that the government should publish an annual report on the Civil Service. At the least, such a report might forestall the captious criticism which continually arises whenever the quarterly statistics regarding the Civil Service are published. After all is said, the fact remains that the size of the Civil Service is determined by the duties which it is required by Parliament to perform; hence it depends on the administrative implications of national policy, and only to a very minor degree on the efficiency with which the Service carries out that policy.

These suggestions are designed to focus attention, both within and without the Civil Service, on the primary questions of the proper relations between the governed and the governors, and the procedures, attitudes and ethics which should pervade public administration—and at the local government level as well as at the centre. Without due attention to these primary questions, the right answers and the right emphasis are unlikely to be found when we consider the secondary questions of recruitment, salary scales, working conditions, mobility, flexibility and the position of scientific and professional staff. It is not suggested, indeed, that such questions are unimportant; but a clear conception of the functions of the Civil Service in the modern State and of the functions and responsibilities of the scientific expert must guide decisions as to the best means by which such functions are to be discharged and the character of the organization provided for the purpose.

There are several suggestions made to this end. The idea of a Civil Service training college finds firm support as a means of countering departmentalism, in spite of the increase in staff that it would involve. A deliberate policy of interchange between departments, and between departments and nationalized industries, is advocated, instead of mobility being left to chance, as at present. Sir Edward Bridges notes that to-day, of thirty-three 'permanent secretaries' of major departments, sixteen started their official career in other departments, and four others have spent long periods in other departments; but it is not clear how much advantage is being taken of the new opportunities to avoid compartmentalism.

The symposium appears to suggest that the present system of vesting the ultimate control of the Civil Service in an administrative class drawn mainly from the universities is right; the wider basis of recruitment to the universities is securing a reasonable representation of social classes even though full equality of opportunity has not yet been achieved. The real deficiencies are in what is done in the matter of training; nor can confident answers yet be given to such questions as whether we can make the Civil Service more flexible and reduce rigidity of promotion, grading and salaries so as to permit the encouragement of real merit; though something is being done in the Scientific Civil Service (see p. 999 of this issue). Nor can it yet be said that a system of interchange can be worked out with the universities or with the nationalized industries in spite of the advantages of interchange demonstrated by war-time conditions.

The scientist will note that his own special difficulties and problems are fully appreciated, though there is not in the symposium any adequate treatment of the central problems of the limits of expert knowledge and the presentation and consideration of such advice in the task of government which Mr. D. K. Price's recent book illuminated in the American context. Nothing in the contributions to *The Political Quarterly* suggests that we have really worked out the right role of professional staffs in the Civil Service—medical, scientific or engineering—or that we can assume, without further inquiry, that the very great resources which the government is putting into scientific research and development are being efficiently operated. Even if the Civil Service is attracting a fair share of young scientists of the highest ability, it does not follow that they or their colleagues in government service are not being used for duties which could be performed equally well by others less highly trained.

On these and allied questions the symposium is a challenge to realistic and constructive thinking, both by individual scientists and by their professional organizations. Prof. W. A. Robson's article in particular should be noted by them, with its recognition of the much larger place which science now occupies in the sphere of government, and its strong support for administrative training and responsibility for the professional and scientific classes, and for the deliberate extension of their relevant experience so as to increase their usefulness. If, however, within the next few years satisfactory solutions are not found for the problems of how best to present and utilize scientific and other expert advice in the work of government at all levels, to guide policy and decisions and to secure the efficient utilization of scientific and technical man-power within the Civil Service, some large share of responsibility must clearly rest on scientists themselves for failure to grasp the opportunities now before them.

FOOD PRODUCTION AND POPULATION

World Population and World Food Supplies

By Sir E. John Russell. Pp. 514 + 44 plates. (London: George Allen and Unwin, Ltd., 1954.) 50s. net.

THIS book, with its wealth of information on the present position and possibility of development of agriculture in the different countries of the world, is a valuable addition to the growing literature on the question of whether the population will grow to a size that the earth will not be able to support.

The main cause of the present 'explosion' of population is, of course, the application of modern preventive medicine in reducing disease in countries with a high death-rate. In the limited areas where it has been applied, the population is increasing at a rate which will double it in less than thirty years. In recent years, with the help of the World Health Organization and other agencies, practically all countries are now beginning to apply modern hygiene. Hence, estimates of the size of population in the future have had to be revised upwards. In 1946 it was estimated that the population of about two thousand million before the Second World War might reach four thousand million by the end of the present century. The latest estimate is that it may reach that figure by 1980 and, if the present accelerating rate of growth continues, between five and six thousand million within the subsequent fifty years.

It is obvious that the only solution of the population problem is the reduction of the reproduction-rate to the level of the replacement-rate. There is commendable propaganda for birth control to attain that end; but owing to religious opposition, and the fact that many countries are taking measures to maintain or increase the birth-rate, it is doubtful whether the propaganda will have much immediate effect. Some take a gloomy view of the future. The present rather sudden rate of increase of population is, however, not a new phenomenon. It occurred in Western Europe in the eighteenth century, when the population of England and Wales, for example, rose from about ten to thirty-three million in spite of large-scale emigration. It is estimated that between 1800 and 1924 about sixty million people left Europe. Early in the present century, Western Europe passed through this phase of rapid expansion of population, and the birth-rate is now so low that the Western German Minister of Home Affairs recently pointed out that, unless voluntary birth control can be reduced, the European race is on the decline. It is probable that, when the countries at present in the expanding phase of population reach the standard of living and education of Western Europe, the birth-rate will fall and world population will become stable or perhaps even decline. This, however, is by no means certain. In the United States there has been a rise in the birth-rate, and the percentage rate of increase now rivals that of India.

It is impossible to predict with any degree of certainty the size to which world population may grow. The compulsory checks are war, disease and famine. If the attempts to eliminate the first two be successful, then, apart from voluntary birth control, which may take a long time to be effective, there remains only famine. This raises the vitally important question of whether population growth will outrun the capacity of the earth to produce food. On this there are two views, both of which warrant serious consideration.

One, put forward by Vogt, is that owing to soil erosion, which has destroyed about half the original fertile land on the earth and is still continuing, the only way to avoid famine is by birth control, compulsory if necessary, and the stopping of the elimination of disease in over-populated countries until the population is reduced to what the country can support. The other view, like that of Rosin and Eastman, is that with modern technology there is practically no limit to the amount of food that can be produced.

The information given in this book supports the latter view, at least to the extent of showing that a great increase of food production is possible. For example, in India, which is usually quoted as the outstanding case of an over-populated food-deficit country, the use of fertilizers in proper amounts would increase the yield of different crops by 30–100 per cent. The cultivation of rice by the Japanese method, using fertilizers, increases the yield more than 100 per cent. Then there are more than a hundred million acres of fertile land overrun by weeds and jungle which could be cleared by bull-dozers. Shortage of water is a limiting factor in agriculture, but less than 10 per cent of the water in the rivers is used for irrigation. With pumps for small areas and multi-purpose dams like the Damodar Valley project, to convert the destructive force of floods to electricity and provide water for irrigating, vast areas could be brought into cultivation.

The physical possibilities for increased production in India are very much the same for all food-deficit countries. If the land at present under cultivation, or which could easily be put under cultivation, were made to yield to its maximum, the food supply of these countries could be doubled. Soil erosion could be stopped and the ruined land reconditioned. But technology cannot be applied to bring about the rapid increase of food supplies in the food-deficit countries owing to the lack of the necessary fertilizers, agricultural equipment and other industrial products. Where these are available, together with the incentive of a guaranteed market, food production can be

rapidly increased, as occurred during and after the Second World War in Britain, when production was increased about 30 per cent, and in the United States, where surpluses have piled up to the value of 6,229 million dollars by March of this year. In the food-deficit countries the main obstacle is the lack of the necessary industrial products which they are too poor to purchase. The average income in these countries is only about £20 per head—less than a tenth of what it is in Western European countries. Though the Food and Agriculture Organization, the American and the United Nations Technical Assistance Scheme, and the British Colombo Plan are doing excellent work with their limited funds, progress is too slow. Up to 1951 world population had increased by 12 per cent since the Second World War, while food supplies had increased by only 9 per cent. Owing to three good harvests, the supply per head is now about equal to what it was in 1938, but the greater part of the increase is in the already well-fed countries. In the Far East, even if targets for 1956–57 are reached, production per head will still be about 10 per cent below the 1938 level when 80 per cent of the population suffered from malnutrition and periodic hunger. It is estimated that the long-term investment of about £4,000 million a year—that is, about 10 per cent of what the world is spending on armaments—would be needed to put an end to hunger and poverty within a reasonable time.

With modern engineering and agricultural technology, to the latter of which the author of this book has made a notable contribution, it is now possible to provide sufficient food for all mankind, even though the population should grow to twice its present size. The main difficulty is the adjustment of the economic and political structure of the world to the new age of abundance which science has made possible.

BOYD-ORR

A TREATISE OF GENETICS

Traité de Génétique

Par Prof. Ph. L'Héritier. Tome 1 : le Mécanisme de l'Hérédité Génétique Formelle. Pp. iv+344. 1500 francs. Tome 2 : la Génétique des Populations. Pp. iv+345–518. 900 francs. (Collection "Euclide" : Introduction aux Études scientifiques. Biologie Animale—Section dirigée par Maurice Caullery.) (Paris : Presses Universitaires de France, 1954.)

THERE is an unquestionable demand for an elementary treatise of genetics. One written by Ph. L'Héritier, who has contributed brilliantly and decisively to two fields of genetics, cannot fail to arouse expectations. The two published parts of this treatise, however, though thoughtful and informative, are somewhat disappointing in three respects. First, they lack balance between the various parts of the subject. Second, they wander repeatedly from a logical sequence in the main argument. Third, they ignore the difficulties and evolution of basic ideas such as gene, allele, etc.

For example, in Vol. 1 (the mechanism of formal genetic inheritance) a whole chapter out of a total of six deals with interspecific hybridization, a subject which has limited relevance to formal genetics. The formal genetics of *Drosophila* is given a share far in excess of the very large one which everybody will agree it deserves. In contrast the formal genetics of man, of *Neurospora*, of *Aspergillus*, of cotton, etc., with their distinct contributions to our ideas of mutation, segregation, organization of genes, etc., are barely mentioned, if at all. In Vol. 2 (genetics of populations) the treatment is prevalently theoretical, with little reference to the vast amount of experimental work on populations either in Nature or in the laboratory. This is the more regrettable in view of the distinctive contribution which L'Héritier himself has made to this field.

An example of disconcerting sequence in the logical development of the subject is that multiple allelism and 'pseudo' allelism are dealt with before linkage and crossing-over. An example of avoidance of the terminological and semantic difficulties is the following definition : ". . . the mendelian character is represented in the hereditary make-up by a discrete particle, called the gene . . ." (p. 21).

On the credit side of this treatise there is the very elementary but clear and adequate treatment of the mathematical theory of population genetics, possibly the most extensive treatment of the subject so far still comprehensible to the non-mathematician. In the first volume, linkage and mapping of the chromosome are treated in a very satisfactory and intelligible way at the elementary level. The last chapter, on the mechanism of mutation, again gives an excellent bird's-eye view of a field which is at present rather fluid.

On the whole, it seems to the reviewer that this treatise, though useful as a reference book for people who are already well versed in the field, will not be equally useful for those who want to acquire a general balanced view of the concepts, the methods and the implications of genetics.

G. PONTECORVO

PLEISTOCENE GEOLOGY AND ARCHÆOLOGY OF NORTHERN FRANCE

Les Limons Quaternaires du Bassin de La Seine

Stratigraphie et Archéologie Paléolithique. (Archives de l'Institut de Paléontologie Humaine : Mémoire 26.) Par François Bordes. Pp. ii+472. (Paris : Masson et Cie, 1954.) n.p.

THIS magnificent volume of the Archives de l'Institut de Paléontologie Humaine is of first-rate importance to all students interested in the Pleistocene geology of northern France and the succession of early Palæolithic industries in the region. In conjunction with Commont's work in the Amiens district and the volume by Georges Dubois on the Pleistocene of northern France which was published by the Société Géologique du Nord in 1924, it gives a picture of the late geological succession in the north-eastern part of the country.

The importance of F. Bordes's new work is not so much in his conclusions but in the fact that he gives such a very large number of sections in gravel and loess pits along the River Seine from Paris to the sea and some others from neighbouring districts. Sections in the Amiens district are given to allow correlation with the work of Commont in the Somme valley. Each section has been carefully studied, and any finds, faunal or archæological, are recorded. Pages of illustrations of implements found are given. The conclusions arrived at, though clearly given, are

subservient to the evidence upon which they are based. Whatever may be the final verdict on the Pleistocene successions in the valleys of the Seine and Somme and the correlation of the archæological and geological records, the facts recorded in this volume will have to be taken into account and will provide the basis for the resultant conclusions.

After a first part dealing with methods of study, the sections in a number of pits in the Paris region are considered, and afterwards the Mantes–Vernon area is dealt with in some detail. There follow accounts of sections and finds in the regions of Evreux–Nogent-le-Roi, Gisors–Fleury-sur-Andelle, Elbeuf, Rouen–Neufchâtel, Pont-Audemer and Duclair–Fécamp–Le Havre. For purposes of comparison there follow studies of sections in the Amiens, Beauvais–Clermont and Meaux–La Ferté-sous-Jouarre areas. Then comes the third part of the book, namely, several chapters dealing with the loesses of the region. M. Bordes divides the younger loess into three levels and the older loess into two. He considers the mode of deposition of the material, the fauna contained and the climate under which it was laid down. He studies the evolution of the human industries and their correlation with the loess levels, and ends with three short pages of general conclusions.

An excellent bibliography and list of the sites investigated, together with a map of the district covered, conclude the volume. Altogether, this is a first-class work, full of facts both from the geological and archæological angles, and all students of the subject will welcome it. M. C. Burkitt

ELECTRICAL MACHINES AND TRANSFORMERS

Electro-Magnetic Machines

By Prof. R. Langlois-Berthelot. Translated and revised in collaboration with Lieut.-Colonel H. M. Clarke. Pp. 535. (London: Macdonald and Co. (Publishers), Ltd., 1953.) 65*s*. net.

When one reads the first sixty pages of this book, one gets the impression that it was written for youths, say, of fifth-form standard. But on reading further one soon realizes that the author's aim is more ambitious, and it appears that a sound knowledge of at least the elements of calculus and vector analysis is required for the full understanding of the book. But those who are not interested in the mathematical treatment of the subject will also find the book attractive, inspiring and thought-provoking. At a time when so much is spoken and written about the necessity of providing in Britain more opportunities for the education of technologists, the few pages in the last chapter on the relation between scientific and technical points of view and on the field of industrial research should appeal to many readers. Technological aspects are given prominence throughout. A special feature of the book is that the general principles and rules are outlined in a straightforward manner and that afterwards various complications to be met with in applying the rules are stated.

The book is written in that clear, logical style to be expected from a French author, and a word of praise should also be said about the competent translation. Much information is contained which is not to be found collected together elsewhere. In this connexion, mention should particularly be made of the chapters on insulation and on ventilation, as well as the section concerning standardization of dielectric test requirements and the concise treatment of transient conditions.

Numerical examples scattered all over the book will prove helpful to the student and designer, and occasional hints for practical exercises to be performed by students will be welcome to the teacher; although he will miss, perhaps, specific problems usually to be found in British and American textbooks of this kind.

The six main parts of the book deal with the following: the family of electrical machines; general anatomy and physiology of electrical machines; the machine from the designer's point of view; the machine from the user's point of view; abnormal conditions of operation; and miscellaneous general comments, including a general introduction to technique of electrical machines. Some appendixes deal with the notations and symbols used, with simple relations like sinusoidal functions, complex quantities and polyphase systems, and with a brief introduction to circle diagrams and the like.

While the book deals in a general way with transformers, synchronous and asynchronous alternating-current machines, single- and three-phase collector machines and direct-current machines, further volumes are apparently planned by the author, a second one being already in preparation dealing in greater detail with transformers and alternators.

A few critical remarks may be permitted. It is somewhat astonishing that under the heading "Various Special Machines" no mention is made of the direct-current cross-field machines invented just fifty years ago by E. Rosenberg. They have been extensively used for lighting railway trains, the feeding of searchlights and for arc-welding purposes not only in Germany and Austria but also in France, where before the First World War quite a number of trains of the P.L.M. Railway were equipped with them; and also their further development connected with the name of Pestarini might have been mentioned, as the 'metadynes', 'amplidynes', 'rototrols' and 'magnicons' are now frequently used in regulating technique—for example, as auxiliaries for the excitation of large and small alternators or of the generators of Ward-Leonard sets.

In a book of this size, perhaps more emphasis could have been laid on the importance of a good power factor in induction motors. True, the power factor is mentioned in several places, particularly also in the appendix. But in the part dealing with the machine from the user's point of view a warning might have been expressed against installing outsize induction motors in industrial plant, since this happens frequently in practice; as the power factor declines markedly at partial loads, an undesirable inductive load must be carried by the supply mains in these cases.

Very few misprints have been noticed, but one must be mentioned. In the explanation of the positive and negative phase-sequence on p. 447, the compositor apparently omitted half a sentence. But all these are minor blemishes, and the book can be strongly recommended and is a very welcome addition to the literature of electrical machines, in spite of the fact that this is already rather extensive. Author, translators and publishers can be congratulated upon this production. R. Neumann

Les applications de la mécanique ondulatoire à l'étude de la structure des molécules

Réunions d'études et de mises au point, tenues sous la présidence de Louis de Broglie. Pp. 224+2 plates. (Paris : Éditions de la Revue d'Optique théorique et instrumentale, 1953.) 1600 francs.

THIS volume contains the text of the eleven lectures and introductory address delivered at the eighth in the series of annual conferences on physical topics which have been held since 1944 under the general presidency of Prof. Louis de Broglie. Applications of wave-mechanics to the study of the structure of molecules was the topic chosen for the 1951 conference, and the lectures were delivered on various dates during April–June of that year. Both experimental and theoretical applications are featured. J. Lecomte gives an interesting and informative review of progress in the technique of infra-red spectrometry during 1940–50, and J. Wyart discusses the determination of interatomic distances by X-ray and electron diffraction, while O. Chalvet and C. Vroelant deal briefly with the theoretical calculation of interatomic distances.

On the more chemical side there is an excellent description by P. Ramart-Lucas of the influence of the steric effect on the electronic structure of carbon and nitrogen, and this is supplemented by a discussion by C. Sandorfy of the theories of the electronic spectra of organic molecules. In the sequence of three papers by N.-Q. Trinh, H. Lumbroso and A. Laforque, respectively, considerable detail is given, together with numerous references, of the work on electrical polarization and dipolar moments, and A. Pacault, N. Lumbroso and J. Hoarau in a short article briefly refer to the evidence concerning the structure of molecules to be gained from measurements of magnetic anisotropy.

The two remaining articles in the volume are of a more general nature. The first, by R. Daudel, is of an introductory character and outlines the part played by the de Broglie wave in the study of the structure of molecules, pointing out that there is no difficulty in principle but solely in the numerical solution of the wave-equation applicable to the particular case. The second article, by P. Chanson, describes the various methods used to obtain visual pictures of the atoms and molecules.

Though the lectures were delivered in 1951 and published towards the end of 1953, a useful attempt has been made by several of the authors to bring their material up to the date of publication by the addition in footnotes of brief references to recent important contributions. S. WEINTROUB

Rotgrünblindheit als Erlebnis

Führer durch die Farbwelt für Rotgrünblinde. Von Dr. Heinz Ahlenstiel. Pp. viii+47. (Göttingen : "Musterschmidt", Wissenschaftlicher Verlag, 1951.) n.p.

THIS little book, which first appeared in 1951 but which has since been translated by Mr. R. W. Burnham and printed privately by the Eastman Kodak Co., is an intriguing attempt by the author to describe the world of colour as seen by the colour-defective, the author himself being a protanope (the type of defective frequently described as red-blind).

Certain aspects of the treatment may seem a little naïve, but there are some thought-provoking references both to the difficulties which face the colour-defective and also to effects which the intelligent and observant colour-defective can use to help him. This is well illustrated, for example, in the case of red object colours, which are, of course, a frequent source of confusion to persons with poor colour discrimination. In the first place, as the author points out, red objects possess an abnormally high purity to the colour-defective, even though their basic (defective) hue is yellow ; and secondly, many red dyes and pigments are dichroic. This dichroism is such that, in thick layers, the appearance will, to the red-defective, be dark yellow, but in thin or diluted layers a light greyish-blue. Hence, a red surface of paint or fabric is likely to possess, on account of inevitable variations in density of the dye or pigment, a characteristic texture of yellow and blue which will enable the observer to identify the surface as red !

Effects such as these are not readily anticipated by a person with normal colour vision, and this book will prove stimulating reading not only to those interested in colour vision, but also to anyone of a philosophical turn of mind concerned with visual experience. W. D. WRIGHT

The Physics of Viruses

By Ernest C. Pollard. Pp. xi+230. (New York : Academic Press, Inc. ; London : Academic Books, Ltd., 1953.) 5.50 dollars.

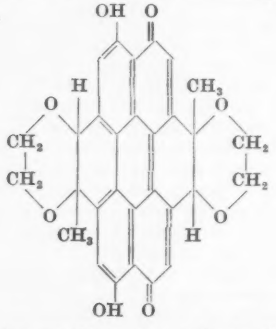
THERE is need for a book which catalogues and describes the many different techniques which the physicist has brought to the aid of the biologist, and especially the virus worker, during the past twenty years. However, it is never quite clear what the intentions of the author of this little book were, and to whom it is really directed. The treatment is too patchy and incomplete to make the work of value as a laboratory manual for the biophysicist, and the numerous erroneous statements about viruses will scarcely commend the book to the pathologist seeking a brief and reliable survey of the physical methods open to him.

The opening sentence consists of a definition of a virus that is so unrestrictive as to include ionizing radiations and many inorganic ions ; such carelessness is regrettably only too common in many parts of the book. In Chapter 2, for example, Dr. E. C. Pollard mentions the use of the electron microscope for particle counting, but does not say that special techniques are necessary for the purpose, let alone describe them. Later in the same chapter, the description of, and references to, the techniques for cutting the very thin sections essential for electron microscopy are so incomplete as to be altogether misleading to anyone not already acquainted with the subject, and too many of the few electron micrographs included are of indifferent technical quality. The combined result gives no indication whatever of the range, scope and limitations of the instrument in virus research.

These deficiencies, serious though they are, should not be allowed to obscure the fact that the book does contain what is probably the only short account of the very large amount of work done since 1946 using ionizing radiation as a tool in virus research. Here the author, a nuclear physicist, is on his home ground, and this is easily the best part of the book. There are author and subject indexes, and the book is produced to the high standards one has come to expect of the Academic Press. It is a great pity that the care and obvious ability of the publishers are not matched in the text. H. L. NIXON

CHEMISTRY OF SOME NATURAL PIGMENTS

At the meeting of the British Association this year in Oxford, a symposium was held on September 6 on "Complex Natural Colouring Matters". After a short introduction by Sir Robert Robinson, Sir Alexander Todd gave a lucid account of the recent work which has been carried out in the Cambridge laboratory on the structure of aphins, the pigments obtained from the hæmolymph of various species of Aphidiae. For each species so far examined, the following four types of compounds have to be considered: the water-soluble protoaphins, which are probably glycosides and represent the 'native' precursor of the pigments; the fat-soluble xanthoaphins which are formed after the death of the insect by enzymic action; the orange chrysoaphins representing an intermediate state in the transformation chain; and the deep-red erythroaphins which represent the relatively stable end-products of each series. The two series which have so far been examined in detail are the aphins-*fb* obtained from *Aphis fabae*, the blackfly which attacks broad beans, and the aphins-*sl*, derived from *Tuberolachnus salignus*, the willow aphid. The contribution of Sir Alexander Todd was concerned entirely with the structures of erythroaphin-*fb* and erythroaphin-*sl*. Papers already published in the *Journal of the Chemical Society* have shown that both these two substances have the formulæ $C_{30}H_{22}O_8$, that they contain two carbonyl groups (quinone) and two hydroxyl groups, while the remaining four oxygen atoms are inert and are probably present in an ether linkage. The results of zinc dust distillation and of examination by infra-red and ultra-violet spectroscopy have shown that there is present in both compounds a 4 : 9-dihydroxyperylene-3 : 10-quinone structure. The structure now proposed for the two erythroaphins is based on the following arguments.



Substitution reactions show clearly that positions 2, 5, 8 and 11 in the perylene nucleus are free. Zinc dust fusion yields, among other products, a coronene derivative, suggesting that the saturated part of the molecule is attached to the perylene ring at positions 1 and/or 12 and 6 and/or 7. The formation of acetaldehyde on heating with hot 60 per cent sulphuric acid, and also symmetry considerations, make it appear probable that in these two erythroaphins two dioxan rings are fused with the central perylene nucleus.

Both erythroaphins are optically active, but their specific relations differ markedly. From the fact that erythroaphin-*fb* yields 1·7 moles of acetaldehyde and erythroaphin-*sl* only 0·8 mole, it is deduced that the two alicyclic ring junctions in the former are both *cis*, whereas in the *sl*-isomer one junction is *cis* and the other is *trans*. This deduction is in accordance with modern concepts of the stereochemistry of elimination reactions and also provides a satisfactory explanation of some of the complex interconversion and isomerization reactions of the erythroaphins and their derivatives. Although the structures proposed may not be established with complete certainty, all the known facts, physical and chemical, fit beautifully this ingenious interpretation.

The second contribution, by Prof. R. P. Linstead, was mainly concerned with recent work carried out in the Chemistry Department of the Imperial College of Science and Technology, London, on the chemistry of chlorophyll. This pigment, which plays an important part in photosynthesis in plants, is chemically related to the porphyrins; but, whereas the porphyrins are red and show five discrete absorption bands in the visible and near ultra-violet regions of the spectrum, chlorin, the basic macrocyclic structure present in chlorophyll, is green and is distinguished by a strong and sharp band in the red region. It has been shown, mainly by the work of the late Hans Fischer, that chlorins possess two more hydrogen atoms in the ring system than the corresponding porphyrins, and these additional hydrogen atoms are mainly responsible for the differences in colour and presumably of biological function of these two classes of complex organic molecules. The introduction of these two hydrogen atoms also creates a new element of asymmetry in the molecule and accounts for the optical activity of chlorophyll and its derivatives. Porphyrins are optically inactive, unless they acquire asymmetrical carbon atoms in their side-chains.

The placing of these two hydrogen atoms in the ring system proved to be a particularly difficult problem which was only solved in principle by Fischer in 1940 by oxidative degradation of various chlorophyll derivatives. Oxidation of porphyrins with chromic trioxide has been used for a long time in structural studies; thus with mesoporphyrin, which is related to the protoporphyrin of hæmoglobin, it produces two molecules of ethylmethylmaleimide, derived from the two non-acidic rings I and II, and two molecules of a maleimide propionic acid (hæmatinic acid), derived from the acidic rings III and IV. In 1940, Fischer and Wenderoth succeeded in isolating from a chlorophyll derivative in the form of a silver salt a dihydrohæmatinic acid which was optically active. This observation, together with other available knowledge, indicated that the two hydrogen atoms occupy the β-positions in ring IV. However, Fischer was unable, by the methods then available, to obtain the dihydro acid in a crystalline state, nor was it possible to determine the steric configuration of the compound.

Prof. Linstead and his colleagues have tackled the problem of the 'extra hydrogens' in three ways: in the first place (with Dr. M. Whalley), stable extra hydrogen atoms have been introduced into tetramethyl tetrazaporphin, which is a compound of related structure in which the four methene bridge groups are replaced by nitrogen. This azaporphin took up on catalytic hydrogenation four atoms of hydrogen. On oxidation, good yields of *meso*-1 : 2-dimethyl-succinimide and dimethylmaleimide were obtained, indicating that the hydrogen atoms had

indeed entered into the β-positions. This work also demonstrated that the tetrahydride structure involving the β-positions corresponds to a moderately stable reduction-level, at least in the azaporphin series.

Although porphin, the completely unsubstituted porphyrin, had been known for some time, the corresponding chlorin had so far not been synthesized. Prof. Linstead and Dr. U. Eisner have now obtained this substance in the following manner: pyrrole is converted by a Mannich reaction to 2-dimethylaminomethylpyrrole, and this on treatment with a Grignard reagent yields a complex mixture of pigments from which chlorin is isolated in low yield by counter-current distribution and chromatography. The light absorption of the chlorin is extremely close to that observed by Stern with the various natural chlorins supplied by Fischer. Chlorin also gives the correct analysis for a dihydride and can be converted to porphin.

Finally, Prof. Linstead described recent work with Dr. G. E. Fichen on dihydrohæmatinic acid. This compound possesses two dissimilar asymmetric carbon atoms and will therefore exist in two racemic forms. The anhydrides, the imides and various salts of both series have been prepared, and a relatively easy interconversion from one series to the other has been observed to take place. Natural dihydrohæmatinic acid has been prepared by oxidation of pyrrophæophorbide-*a* (a degradation product of chlorophyll *a*) and has been separated from methylethylmaleimide by chromatography on silica gel. The natural substance has $[\alpha]_{5893} = -51°$. In respect of all other properties examined, it closely resembles one of the two racemic materials prepared by synthesis. The configuration of the two asymmetric carbon atoms has not yet been determined, and further developments of this work will be of great interest.

The third contribution, by Dr. A. Neuberger, was concerned with the biogenesis of porphyrins. After a short survey of their biological role, the structure of some of the naturally occurring porphyrins was briefly discussed and the point was emphasized that all the porphyrins associated with proteins are formally derivable from ætioporphyrin III, that porphyrins of type I are also found in Nature, while isomers of the series II and IV are apparently not synthesized by living matter.

From the wide distribution of cytochromes and catalase it can be deduced that almost all cells can synthesize porphyrins, but up to eight years ago there was no information as to the nature of the precursors. However, in 1946, Shemin and Rittenberg showed by means of labelling with heavy nitrogen that the nitrogen of glycine is used in a highly specific manner in the synthesis of protoporphyrin. Later work done in the United States by Shemin and in Britain by Muir and Neuberger produced convincing evidence that all four nitrogen atoms of porphyrin are specifically derived from glycine. When carbon-labelled glycine became available, it was shown by Altman that the carboxyl carbon atom of glycine is not incorporated into porphyrin, while parallel work done in the Columbia laboratories and at the National Institute for Medical Research, Mill Hill, demonstrated that the methylene carbon atom of glycine was used. In fact, for each nitrogen atom of glycine two methylene carbon atoms were found to be incorporated into each of the four basic units. By oxidative degradation it was found that one of these glycine methylene carbon atoms gives rise to the methene bridge, while the other is incorporated into the pyrrolic ring. Later, it was shown by Shemin that one of the two α-carbon atoms originates from the second glycine methylene group. This, of course, accounts only for eight out of thirty-four carbon atoms of protoporphyrin. Experiments with carbon-labelled acetate carried out in Columbia and at Mill Hill suggest that α-oxoglutarate and a substance closely related to it provide all these other carbon atoms; but it has been finally shown by Shemin that the substance concerned is mainly a succinic acid derivative substituted on one of the carboxyl groups, probably the coenzyme-*A* complex of this dicarboxylic acid. The position thus is that each of the four basic units of uroporphyrin can be thought to be formed by condensation of two molecules of glycine with two molecules of a succinic acid derivative and that one of the two nitrogens and the two carboxyl groups of glycine are lost before, during or after this condensation.

The identification of the intermediate between glycine plus succinic acid and the porphyrins has proved to be a difficult task and is by no means completely solved. Neuberger and Muir considered that the basic unit is a pyrrole substituted on one of the α-positions with elements of a potential methene group. This may have been formed by an initial condensation of two glycine molecules followed by combination with succinic acid. However, work with substances such as β-hydroxy aspartic acid was discouraging, and this idea was discarded also for other reasons. If the basic pyrrole has already one of the two α-positions substituted, it is easy to see how the symmetrical porphyrin of type I is formed, but the synthesis of the asymmetrical type III is more difficult to explain. A more reasonable assumption was that the basic pyrrole has two free α-positions, and this pyrrole would then combine with a further molecule of glycine giving one or other of two different α-substituted substances. It was therefore assumed that glycine would condense with succinic acid giving, in the first place, α-amino β-oxoadipic acid which would then be converted by loss of carbon dioxide to δ-aminolævulic acid. This acid might then react with a further molecule of succinic acid to give δ-succinamidolævulic acid, which could be reduced to the hypothetical pyrrole. However, biological experiments showed that the succinamido compound is inactive.

In the meantime, Westall had crystallized porphobilinogen, a substance excreted by patients suffering from acute porphyria. Its structure has been established by Cookson and Rimington as a pyrrole having an acetic acid and a propionic acid side-chain in the two β-positions and an aminomethyl group in one of the two α-positions. Soon afterwards Falk, Dresel and Rimington showed that porphobilinogen behaves as a porphyrin precursor, and it thus seems that the original idea of the Mill Hill workers may be partially correct and that an α-monosubstituted pyrrole is the first cyclic intermediate in the synthesis. From the structure of porphobilinogen it can be inferred that δ-aminolævulic acid itself might be the sought intermediate. This was shown almost simultaneously by Shemin and Russell and by Neuberger and Scott, and confirmed by Falk and Dresel. Recent work at Mill Hill, which was briefly reported by Dr. Neuberger, has greatly strengthened this concept that glycine and succinic acid combine to give δ-aminolævulic acid, which gives rise to porphobilinogen and then to porphyrins.

DUKINFIELD HENRY SCOTT (1854–1934)

By Dr. AGNES ARBER, F.R.S.

A PALÆOBOTANIST, writing in the early nineteen hundreds, spoke of D. H. Scott as then belonging to the same class as Nathorst and Zeiller—these three standing head and shoulders above all others in fossil botany. For Scott this verdict is certainly borne out by his long series of books and memoirs, which covers a period of forty years (1894–1933). So many well-documented obituary notices are accessible (see list at the end of this article) that it would be superfluous to reiterate the facts of his career. In this, his centenary year, I propose to confine myself to a few special aspects of his life and work.

Scott's inborn trend towards a life of research was fostered by his personal circumstances. At the age of thirty-eight he became honorary director of the Jodrell Laboratory at Kew, and from this time onwards he was free from the daily grind of academic duties. Fourteen years later he retired into the country, thus securing a still more leisurely and unhampered existence; but, while he enjoyed the liberty of the amateur, he did not suffer from the amateur's drawbacks. He had been disciplined by reading classics at Oxford; then by an engineering training; and, later, by ten years of teaching—a long enough time to put him in possession of all that this particular form of experience had to offer him. Moreover, the absence of enforced day-to-day contacts did not involve any isolation from the scientific world. Indeed, fifty years ago he had become the focal centre of British botanical life to a degree that now, in this period of specialization and sub-division of the subject, would be impossible for any one man. His commitments included such responsibilities as the chairmanship of the Editorial Board of the *Annals of Botany*, and he did much work in connexion with the learned societies to which he belonged; he also gave unstinted time and thought to helping other research workers, whose indebtedness to him can scarcely be exaggerated. None of these doings was of a mechanical type, and they all lay in the field of his genuine interests and his chosen subject; they left his mind unstrained, so that he could put the best of himself into his studies.

In thinking about D. H. Scott, comparisons with Charles Darwin (forty-five years his senior) present themselves unbidden. Both men had the advantage of freedom from monetary cares, so that liberty and independence came to them naturally; and they had each a happy domestic existence, with an extensive but close-knit background of kith and kin. The minds of both were not so much remarkable for brilliance as for the unwearying tenacity which enabled them to pursue the same problems continuously over many years. This power of dwelling on a subject steadily for an indefinite period was one that Darwin recognized in himself, and it is known to have been a principal factor in the process through which Newton's discoveries came into being. Possibly it was this concentrated tenacity which induced in both Darwin and Scott a strict canalization of all mental energy into science; at least in later life, no branch of literature or of the arts can be said to have played an essential part in the existence of either of these biologists. Another resemblance, which though trivial is perhaps not without significance, is that both men inclined to a certain informality in the presentation of their material. This was partly, I think, a reaction against the pomposity of the professional pundit, and partly an eager desire to appeal to a wider circle than that of initiates. It may be recalled that Sachs expressed regret about the style of writing which Darwin adopted, on the ground that it degraded the severity of scientific thinking (cf. Pringsheim, E. G., "Julius Sachs", p. 167; 1932). Darwin's slightly casual approach finds some parallel in Scott's books, and also in what has been called his 'hearthrug' manner of addressing scientific meetings. Underlying even such petty resemblances, there was undoubtedly a fundamental affinity between Scott and Darwin, which expressed itself in Scott's glowing, though not uncritical, admiration of Darwin's work.

The gains that have accrued to science from the technical progress of the present day, and from the resulting development of team-work research, are as obvious as they are vast; but they are correlated with certain losses, none the less real because they are less tangible. There is one loss, especially, that may in the long run prove tragic. It is that, as the amateur (but not amateurish) pursuit of science—typified, respectively, in a major and a minor form in Darwin and in D. H. Scott—becomes more and more impracticable, contemplative leisure fades irrevocably from scientific life. That uninterrupted periods of still meditation are essential, if the deeper insight is to be won, was recognized even long ago, when the *tempo* of day-to-day existence was much quieter than in our mechanized age. In the seventeenth century, Descartes affirmed that liberty and leisure were a necessity for the purposes of concentrated thought; moreover, he acted on this belief, betaking himself to exiled retirement, to avoid time-consuming distractions. Spinoza, again, though he was not, like Descartes, a man of means, declined a professorial chair, basing his refusal partly on the conviction that he could only teach a class at the sacrifice of his research in philosophy.

Though D. H. Scott's achievements were conditioned by his unhurried existence, which made continuous thinking possible, this does not imply that he consciously adopted the contemplative attitude. My impression is that he was not disposed to give any spontaneous consideration to processes going on in his own mind, though in correspondence he might sometimes be stimulated into revealing a defined position. He wrote to me in 1931, when he was in the seventies: "your letter causes me to enter on the religious duty of self-examination! . . . But am I an Aristotelian or a Platonist? When I read a little of the old philosophers some 55 years ago, my sympathies were certainly with Aristotle, who appeared to talk fairly plain sense. I could make nothing of Plato's philosophy, though I admired his style. . . . My interest is pure Natural History. I like to see things as they are, and to think how they became so. I don't care for Physiology. . . . But neither do I care a bit for . . . 'final patterns, eternal moulds'—all mere imaginations of the philosophising brain". In an earlier letter he had stigmatized logic as "a deceitful guide"; in his own work he relied on a strictly empirical procedure. Empirical conclusions demand, however, a theoretical basis; this, in Scott's case, took the form of a fundamental belief that "similarity (suitably determined)", distinguished from that which could

be recognized as "superficial", might be accepted unquestioningly as "a mark of blood relationship". This belief was stressed in a correspondence which I had with him, in 1930, about parallelism in evolution, as contrasted with the older picture of a monophyletic genealogical 'tree' of the plant world; the visual image of such a 'tree' had, indeed, served him throughout his studies as the frame of reference for his botanical thought. He wrote: "When I have occasionally seemed to favour parallelism ('up to a certain point, you know'—like Mr. Brooke in 'Middlemarch') my idea has not been a bundle of sticks separate all the way up, but rather a Lombardy Poplar, with a trunk bearing a number of long, parallel branches". This partial acceptance of parallelism was an instance of Scott's anxious desire not to turn a blind eye upon arguments militating against his views; he was, moreover, prepared to discard his most cherished theories as soon as he had brought himself to feel that knowledge acquired since his conclusions were reached had proved his evidence to be less than adequate. A cogent example is his relinquishment of the idea of the filicinean origin of seed-plants, which had meant much to him. It is recorded that he was fond of quoting Pope's couplet:

"And spight of Pride, and in thy Reason's spight,
One truth is clear; 'Whatever Is is RIGHT'."

This loyalty to abstract truth had, however, to contend with an innate conservatism, involving a lesser loyalty to the purely Darwinian scheme of things, which had dominated his younger days. As a general attitude to life and to religion, the tolerant form of nineteenth-century agnosticism, which seemed the most consistent position for a convinced Darwinian, was congenial to Scott's turn of mind; but, in his later years, his views tended somewhat more in the direction of theism.

It is perhaps not too far-fetched to suggest that certain traits in D. H. Scott's scientific personality were inherited from his great-grandfather in the paternal line, the Rev. Thomas Scott (1747–1821); D. H. Scott's mother could claim collateral descent from the same cleric, so that there was more than the normal chance of the reappearance of hereditary characters derived from him. To-day, Thomas Scott is most vividly remembered for his friendship with Cowper, and for the fact that "John Gilpin" was first adumbrated under his roof, though not by him. He was, in his time, known widely as a Biblical commentator. In his spiritual autobiography, "The Force of Truth" (edit. 1, 1779), he set forth the process he had gone through in reaching his religious convictions. The passage may be quoted, since it is just what his great-grandson, D. H. Scott, might have written, if he had analysed in eighteenth-century parlance his own cautious and balanced scientific method: "I sat down very coolly to search for the truth, I proceeded very gradually, and with *extreme caution*; I took no opinion upon trust; I gave up none of my sentiments, until the arguments by which I had learned to defend them were satisfactorily answered; nor did I admit any new articles into my creed, till either every objection was obviated, or I was pressed on the other hand with such as were still more unanswerable" (quoted from the 1821 edit.).

D. H. Scott's most conspicuous impact on the study of plants has been through his classic corpus of memoirs on structural palæobotany, begun under W. C. Williamson's inspiration; but a more general effect has radiated from his original training in research (1880–82) under Julius Sachs. Scott himself said that going to work in a German laboratory, when he was in his twenties, was, to him, like a pilgrimage to Mecca to a pious Mussulman. It was fortunate that, at Thiselton-Dyer's suggestion, he decided upon the University of Würzburg, since it is no exaggeration to say that Sachs possessed one of the finest minds that have ever been devoted to plant study. Goebel, his assistant, who was about Scott's age, had been a pupil of Hofmeister (born 1824), and was thus a link with the heroic age of German botany. Sachs himself bore the impress of a wider and deeper intellectual tradition. The Czech physiologist, Purkinje (born 1787), who has been described by Nordenskiöld as ranking among the great geniuses of biological discovery, employed Sachs, from the age of eighteen, as his personal assistant. This relation with Purkinje meant that Sachs, in his formative years, had intimate contact with a man who had been directly influenced by Goethe, for it was the "Farbenlehre" that had stimulated Purkinje's early studies in the physiology of sight, and had led to his friendship with the poet. Sachs's school at Würzburg thus inherited some of the best elements in the stream of biological thought which can be traced back to the Goethe period. After Scott's sojourn in Germany, he introduced unconsciously, wherever he might find himself, the spirit of research with which he had been imbued in Sachs's laboratory, and this spirit—passed on through a succession of younger botanists—continues to work as a living leaven among students of the plant world.

Accounts of D. H. Scott's life and work, in alphabetical order of authors' names: Arber, A., "Dict. Nat. Biography", Supp. 1949, for 1931–40; Oliver, F. W., *New Phyt.*, **33**, 73–76 (1934); Oliver, F. W., *Ann. Bot.*, **49**, 823–40 (1935), with bibliography by Edwards, W. N., and Wonnacott, F. M.; Rendle, A. B., *J. Bot.*, **72**, 83–88 (1934), with D. H. Scott's autobiographical notes; Sahni, B., *Current Science*, **2**, 392–95 (1934); Scott, D. H., *New Phyt.*, **24**, 9–16 (1925) (reminiscences of research in Germany); Scott, D. H., in Oliver, F. W., "Makers of British Botany", 243–60 (1913), for Scott's precursors in fossil botany, and especially for his relation with W. C. Williamson; Seward, A. C., *Nature*, **133**, 317–19 (1934); Seward, A. C., Obit. Notices Fellows Roy. Soc., 205–27 (1934); Weiss, F. E., *Proc. Linn. Soc.*, Session 146, 1933–34, 166–69.

BRITISH WELDING RESEARCH ASSOCIATION

OPEN DAYS

THE laboratories of the British Welding Research Association, at 29 Park Crescent, London, W.1, were open for inspection during November 23–24, the previous occasion being in February 1950. Visitors may well have been surprised at the evident expansion in research effort, with the corollary increases in research facilities, equipment and number of staff during the space of but a few years.

The main research effort is divided equally between steels and the light alloys, though visitors heard and saw something of the working of the Liaison Department, the Library and Information Services, and the other and minor research activities now in hand.

One of the most interesting developments from the steel welding researches is a method for the assessment of weldability of high-strength low-alloy steels by means of a dilatometric method. This method depends on the relationship between hardened-zone

cracking and the temperature at which transformation ceases in the hardened zone. This simple means of assessing weldability was demonstrated. Also on view was some of the work using weldability cracking tests which has led to this development.

Mechanical tests at very high temperatures are being made on specimens cut from weld metal, and the results related to the defect known as hot cracking. In these tests, a 6-kVA. high-frequency generator is used. A wider range of investigation of the same problem is being made, using the 'Murex' hot-crack machine.

An investigation is being made of the problem of fissuring in weld metal; that is, the occurrence of very fine intergranular cracks. It has been found that these are liable to occur for given threshold values of hydrogen content and cooling-rate.

Visitors saw something of some relatively new work on the welding of structural steels, using the self-adjusting arc process. The field of high-temperature brazing was represented, and creep tests of brazed turbine assemblies were in progress.

Good progress has been made in the microscopical identification of inclusions in steel plate and weld metal, using a Reichert *MeA*. metallurgical camera (with polarizing equipment) and a Reichert 'Zetopan' metallurgical microscope for visual work. Here the use of diamond dust for the preparation of metallographic specimens has been invaluable; the technique was demonstrated.

Apart from routine chemical analysis, micro-gas analysis has been increasing in importance during recent years. The latest methods for the determination of hydrogen by vacuum extraction were shown, and the way that these have been adapted to deal with the problems of determining hydrogen, not only in weld metal but also in the parent wire and plate materials. One interesting problem has been the determination of the relative amounts of hydrogen dissolved in the aluminium welding wire and that produced by reaction from corrosion products on the surface. These experimental investigations sometimes require the artificial introduction of hydrogen, and this is done by means of cathodic charging.

The light alloy researches cover a fairly wide range of welding processes and aluminium (and magnesium) alloys, but certain problems with respect to heat flow, dilution effects and porosity have been found to be basic to this field of study.

The work on heat flow, which is derived from an investigation of the welding of heat-treatable alloys, is concerned with the production of basic formulæ by means of mathematical analysis, in parallel with measurements of the thermal cycles characteristic of the weld pool and various positions in the parent plate. Methods have been developed for the location of thermocouples in the plate metal, and also in the weld pool itself. The temperatures can be recorded using a ciné camera with a sensitive millivoltmeter, or, where faster rates are involved, using a cathode-ray oscillograph with a d.c. amplifier and camera. It has been found that the arc and weld pool cannot here be treated as a point source, and some progress has been made in the determination of weld pool shapes by calculation.

An important advance has been made respecting the dilution effect; that is, the extent to which the composition of the weld metal is changed by dilution with melted parent-plate material. Nomograms have been prepared to facilitate the estimation of weld metal composition obtained with particular welding conditions. This has been found to be important in the metal-arc welding of *H*.10 plate and in the tungsten-arc welding of a high-strength heat-treatable aluminium alloy, in particular with regard to the development of suitable filler-wire compositions. In the assessment of joint properties in light alloy materials, porosity is especially important. For the measurement of porosity a code has been drawn up for its assessment under the microscope, following detailed investigations. Visitors were able to see the method used for the measurement of elongation over small gauge lengths, found necessary to investigate the variation in ductility across a welded joint. Various forms of weldability cracking tests were shown, in some of which slotted plates are used to give quite severe conditions without the necessity of employing rigid and cumbersome jigs.

Investigations are also in progress on a number of specific alloys, including the metal-arc welding of *H*.10 plate from the point of view of eliminating cracking and porosity, the development of improved filler materials for *H*.14, *H*.15 and *D.T.D*.683 alloys, and the self-adjusting arc welding of *NP*.5/6 alloy.

The relatively new self-adjusting arc process has naturally required some investigation, and, in particular, work on the fundamental characteristics of the process has been done in co-operation with the Electrical Research Association. The effect of power source characteristics on the degree of self-adjustment has been determined. In parallel, work has been done on drift in power source output. This is making possible the development of idealized generators for the process, or at least the modification of existing generators in this direction. The efficacy of the improved power source characteristics was demonstrated by comparative welding tests over a stepped plate.

OBITUARIES

Sir John Lennard-Jones, K.B.E., F.R.S.

The death on November 1 of John Edward Lennard-Jones has deprived British theoretical chemistry of its most senior and distinguished representative. Yet he did not begin his career as a chemist. Born in 1894, he was educated at the University of Manchester and then at Trinity College, Cambridge. The First World War interrupted his studies and he became a flying officer (pilot) in the R.F.C. and later experimental officer at the Armament Experimental Station, Orfordness. In 1919, however, he returned to the University of Manchester, this time as lecturer in mathematics. This post was followed by a readership in mathematical physics and later the first professorship in theoretical physics, both at Bristol. It was during this time that he became deeply interested in the nature of interatomic forces, and introduced the semi-empirical law of force $a/r^n - b/r^m$ with which his name will always be associated. These Bristol years were productive of other new ideas, and in particular it was then that Sir John initiated the wave-mechanical study of molecular structure in the form of molecular orbitals. His first paper on this topic, published in 1929, is still a standard piece of work, and the whole subject owes a great debt to him for the way in which he brought out in a simple way the mathematical implications of experimental studies on quantum numbers in molecules then being made by R. S. Mulliken and others.

This migration from mathematics through physics to chemistry made him an excellent holder of the John Humphrey Plummer chair of theoretical chemistry established at Cambridge in 1932. At the same time (1933) he was elected a Fellow of the Royal Society. This post at Cambridge was—and still is—the only chair of theoretical chemistry in Britain. While he was in Cambridge, Lennard-Jones (or 'L. J.' as he was known to his many friends) laid the foundations of the present vigorous school of theoretical studies in Britain. During this time he extended his earlier work on molecular orbitals, he made some useful progress in the very difficult field of chemical interactions at a metal surface, and he developed the 'cage-model' of liquids. Had it not been for the Second World War, in which he played a conspicuous part as Superintendent of Armament Research and Director-General of Research (Defence) at the Ministry of Supply, there is no doubt but that he would have done even more.

At the end of the War, Sir John returned once more to Cambridge, and although he became chairman of the Scientific Advisory Council of the Ministry of Supply, he and his younger colleagues completed an extensive study of the most fundamental problem in all chemistry—what is meant by a chemical bond? But by this time his administrative abilities were becoming widely known. He was a member of the Advisory Council for the Department of Scientific and Industrial Research, a member of the Scientific Advisory Committee of the National Gallery, and president during 1948–50 of the Faraday Society. His quiet manner and understanding approach to difficulties made him an excellent chairman on all occasions where conflicting claims had to be reconciled. It was not surprising, therefore, that in April 1953 he was invited to follow the late Lord Lindsay and become the second principal of the new University College of North Staffordshire at Keele. He threw himself whole-heartedly into this work, which he so evidently liked, and in which he had become much appreciated, not only in the College itself, but also in the neighbourhood.

Sir John received many honours. He held the D.Sc. of Manchester and the Sc.D. of Cambridge; he was made K.B.E. in 1946, was awarded the Davy Medal of the Royal Society in 1953, and an honorary D.Sc. at Oxford on the occasion of the British Association meeting there only a few weeks before his death, when he was president of Section B (Chemistry). He had recently been awarded the Longstaff Medal of the Chemical Society. All those who knew him respected the complete integrity of his life, the exceptional simplicity and clarity of his lectures and his obvious enjoyment of everything that he did. His home life was a most happy one; he is survived by his widow, a son and a daughter.

C. A. COULSON

Mr. B. H. St. J. O'Neil

THE unexpected death on October 24 of Brian Hugh St. John O'Neil at the age of forty-nine has deprived the Ancient Monuments Department in the Ministry of Works of the chief inspector who followed Mr. J. P. Bushe-Fox, whose death was so recently recorded in these pages (*Nature*, November 6, p. 860).

Educated at Merchant Taylors' School and St. John's College, Oxford, of which he was a scholar, Mr. O'Neil began a career in the City of London, but soon deserted to Westminster and the Ancient Monuments Department in fulfilment of interests always near his heart. His most particular delight was in medieval and post-medieval fortifications and in early artillery, of which he had a profound and detailed knowledge, well employed, for example, in a recent visit to advise upon the treatment of early Portuguese fortifications in West Africa. He spoke and wrote of these matters with an authority and relish good indeed to meet. But his work extended also with distinction to other fields. He was no mean numismatist, as his classic study of Theodosian silver coin-hoards in late fourth-century Britain proves. He could take a prominent part in discussions concerning late-Roman copies of earlier coinage. No less notable was his discussion of the Silchester dykes and their relation to Britons and Saxons. Among his field-work should be specially cited his excavation of Frith Ffaldwyn Iron-Age fortress in Powys and the Caerau settlement in North Wales, and the unstinting unofficial help accorded in the excavations by his wife of Roman villas at Park Street, Whittington Court and Bourton-on-the-Water.

His appointment as chief inspector of ancient monuments brought him into close quarters with war-time and post-war problems in archæology. The application of State aid to the examination and record of sites threatened by destruction was liberally and wisely interpreted by him, and presently extended to cover sites of national importance which private resources, impoverished by taxation and inflation, were no longer equal to tackling. This was a valiant service to knowledge of which the full effects are not yet apparent, for he was planning publication in promising fashion, talking of the matter with the writer less than a week before his death. We have lost far too soon a judicious innovator, a good (if perhaps fatally self-sufficient) administrator, a zealous public servant, a keen scholar and a staunch friend, who in all these capacities will be widely and deeply mourned.

I. A. RICHMOND

Miss Rosamund F. Shove

AFTER a long illness borne with great fortitude, Miss Rosamund F. Shove died on October 17 in Richmond Hospital, aged seventy-six. Until the last few months of her life she had hoped to renew some of her many activities in the field of science and remained keenly interested to the end. Educated at Girton (1896–99), Miss Shove was trained in research by Prof. A. C. Seward; and in 1900 "The Morphology of the Stem of *Angiopteris erecta*" appeared in the *Annals of Botany*. Miss Shove's professional career included seventeen years of science teaching in schools, followed by twenty years of university and training college work in biology and hygiene. Her last post was at the Maria Grey Training College (1921–38). She served on the council of the Linnean Society during 1943–47.

In 1937 Miss Shove became honorary secretary of the School Nature Study Union, and in 1940 undertook the editorship of its journal, *School Nature Study*, at a critical time. She sustained both the Union and the journal throughout the War and continued her labours until 1953, when the jubilee number was published. The journal had appeared regularly each quarter, thanks to her tireless devotion.

At the British Film Institute, Miss Shove was a faithful member of a volunteer panel who viewed natural history films from many sources. She con-

tributed many film and book reviews to *School Nature Study*, besides several illustrated articles based on her discriminating observations; for example, a life-history of a beautiful, ineradicable weed, a pink-flowered *Oxalis*.

Her small garden at Kew contained many cherished plants, some under glass; in the large collection of dwarf trees, each in its own pot, are an English elm forty-two years old and a youthful common lime. I was delighted to learn that this collection had been accepted recently for the Royal Botanic Gardens, Kew.

Other evidence of the lasting influence of a gifted botanist will be passed on by her many grateful pupils, students, colleagues and other friends.

Madeline Munro

NEWS and VIEWS

Botany at Singapore: Prof. R. E. Holttum

Prof. R. E. Holttum, who was the first professor of botany in the University of Malaya, has just retired after spending the greater part of his life in Malaya. He intends to live at Kew, where he will continue his studies on Malayan plants, particularly ferns. Prof. Holttum was born at Linton in Cambridgeshire and was educated at Bootham School, York, and St. John's College, Cambridge. He took the Natural Sciences Tripos with first-class honours in Parts I and II, winning the Frank Smart Prize in 1920. He first went to Malaya in 1922, when he joined the staff of the Botanic Gardens. He was appointed director of the Gardens in 1925, and remained at this post until 1949, when he joined the newly created University of Malaya and brought the Department of Botany into being. Prof. Holttum's appointment was particularly valuable in the early and formative years of the University, for he has travelled widely through Malaya, Borneo and Indonesia and has an unparalleled practical knowledge of the flora of this region. During the past five years he has been very active and has set a tradition that his successor will find it hard to surpass. He has published many papers on ferns, bamboos, gingers and orchids, which are his principal botanical interests, and the past two years have been marked by the publication of some of his major works: "Orchids of Malaya" (Singapore, 1953), "Gardening in the Lowlands of Malaya" (Singapore, 1953), "Plant Life in Malaya" (London, 1954); a fourth volume, "Ferns of Malaya", is in the press. Prof. Holttum's activities in Singapore have been by no means confined to botany, for he has taken a leading part in various important societies. He will be remembered with affection by his students, his colleagues and his many friends in Singapore, who wish him a long and happy retirement near the Royal Botanic Gardens at Kew.

Research in British Power Industries: Gas and Electricity

In a debate in the House of Commons on November 9 on the annual reports and statements of accounts of the gas and electricity industries, the Minister of Fuel and Power, Mr. Geoffrey Lloyd, said that he had agreed with the Gas Council for capital expenditure this year of £61 million. Electricity development was estimated by Lord Citrine at £1,250 million over the next six years; it should provide 1·6 million kilowatts next year and 1·95 million kilowatts in 1959. This includes a five-year programme costing £50 million to bring electricity to 70 per cent of the farms and 80 per cent of rural housing of Britain. In the first half of this year, industrial consumption of gas increased by 8 per cent and that of electricity by 14 per cent; but the gas industry had saved 250,000 tons of coal last year and the electricity industry 1 million tons. Mr. Lloyd also referred to research on the utilization by the gas industry of inferior and cheaper coals, and to the discovery of a process for making gas from fuel oil alone, for which sixteen new plants are being erected. Questioned by Mr. A. Robens as to whether sufficient money was being spent on research in these two industries, the Parliamentary Secretary to the Ministry, Mr. L. W. Joynson-Hicks, said that the figures quoted by Mr. Robens, £229,000 for the gas industry and £242,900 for the electricity industry, did not represent anything like the full expenditure on research of these two industries. Much of the expenditure, he said, is of a capital nature which is not specifically allocated to research; much work is also being done by the British Electrical and Allied Industries Research Association, and the British Electricity Authority contributes to research being carried out by at least half a dozen other bodies. He promised to attempt to obtain a figure for the total expenditure on research by the industries, but was of opinion that research is not being held up on financial grounds.

Nuclear Power

Mr. Lloyd, referring to nuclear power, emphasized the dependence of industrial power from this source upon the ordinary electricity supply system, the expansion of which is already being planned to feed industry from nuclear power stations when the practical difficulties have been overcome. Mr. Lloyd explained why at present in the experimental atomic power stations steam generation is not close-coupled with the furnace, and also referred to the problem of nuclear fuel and the possibility of utilizing as fuel most of the uranium extracted from the ore. Engineers from the British Electricity Authority are already attending training courses at Harwell, and from now on there will be a steady stream of electrical engineers attending these courses. The British Electricity Authority is collaborating closely with the Atomic Energy Authority, and also with the plant manufacturers, in the design of experimental nuclear power stations by making freely available its experience regarding turbines and power-station construction generally. Mr. Lloyd also said that, with the view of encouraging enterprise and, where proper, a spirit of adventure, the Government has decided to encourage these two nationalized industries to compete with each other as actively as possible and with the oil industry. In the course of the debate, Mr. G. Nabarro expressed the opinion that the prototype and pilot nuclear power station at Calder Hall, with a capacity of 60,000 kW., would be completed by the end of 1956, and that such plants would be making a substantial contribution to grid supplies of electricity well within ten years. Mr. Joynson-Hicks, however, maintained that it would be unreasonable, in view of the vast amount of work and planning to

be carried out, apart from research, to expect nuclear energy to be available on a large scale commercially through the grid system of Britain within less than about ten years. He also said that the Government will not overlook the importance of keeping a balance in capital expenditure on the development of nuclear power, on electricity supply generally and on the coal industry.

Nuffield Foundation Grant for Colonial University Colleges

THE Nuffield Foundation has announced that it is setting aside £250,000 for the benefit of the new Colonial university colleges. From this capital sum the University College, Ibadan, Nigeria, and the University College of the West Indies, Jamaica, are to receive grants of £50,000 each; grants to other Colonial university colleges, including a scheme of research into education in the Colonies, are being considered by the Foundation. At Ibadan, £5,000 of the £50,000 grant will be used to build and equip a house—to be known as Nuffield House—for academic visitors. The balance of £45,000 will be held and invested by the Foundation, and the income from this sum for five years will be used to finance a Nuffield visiting professorship for Nigeria. At the end of five years the scheme will be reviewed by the College and the future of the fund will be decided. The first Nuffield visiting professor to be appointed to Ibadan is Prof. P. W. Richards, professor of botany in the University College of North Wales, Bangor, who has published many papers on tropical rain forests. The £50,000 grant to the University College of the West Indies, near Kingston, Jamaica, will be invested in a fund to be known as the Nuffield Endowment Fund. The income from the Fund will be used by the College to finance pilot projects. The choice of projects will rest with the College Council, without emphasis on any particular subject or type of study. The progress of any project so assisted will be reviewed at the end of five years.

Archives of Machine Design: New Polish Journal

THE first number of a new engineering quarterly journal has just appeared; it is entitled *Archiwum Budowy Maszyn*—literally, *Archives of Machine Design*—and is sponsored by the Machine Design Committee of the Polish Academy of Science (Tom 1, Zesyt 1; pp. 120. Warszawa: Polska Akademia Nauk, 1954; 15 zlotys). Summaries of five hundred to a thousand words, in Russian and English, are given at the end of each contribution. This issue comprises four papers of twenty to thirty pages each and one of less than ten; they range over a wide field of mechanical engineering science and treat essentially practical problems from a scientific point of view. The first two papers, on safety factors and a statistical approach to the analysis of failures, respectively, lead to criteria for the more economic design of machine elements. A paper on the conductivity of fibrous insulating materials reports some pure research work with theoretical analysis of the results, some of which are novel. The final paper introduces an improved method for the design of internal combustion engine cams, involving a parabolic variation in the acceleration as a function of time; with the design information given, such a cam should be more effective than the traditional type and no harder to design. This new journal, which shows an outlook intermediate between the German and the Russian, is undoubtedly to be welcomed.

Microscopy of Metals

SINCE Sorby in 1864 first published an account of his work on the microscopic examination of the etched structures of metals, and after an incubation period of nearly two decades, the importance of the microscope in both theoretical and industrial metallurgy has increased greatly. During the past twenty or twenty-five years, in particular, the rate of advance has been spectacular, and the use of polarized light, dark-ground illumination, phase-contrast and the reflecting microscope, among other techniques, has increased its scope of utility enormously. It was therefore appropriate that the refresher course of the Institution of Metallurgists in 1953 was devoted to a consideration of these new, and in some directions quite exciting, techniques. The papers presented are now published by the Institution (pp. 132; from the Institution, London, 1954; 15*s*. 6*d*.) and provide an account, not easily available elsewhere, of the help that the modern microscope can give in the examination of metals and alloys. Five lectures are reprinted, two of which deal with the principles of the microscope and, in particular, of these newer techniques, and with the preparation and examination of the sample. There is then an extended treatment of the use of polarized light and of phase-contrast and interference metallography, and, a matter of growing importance, of the hot-stage microscope for the examination of materials at elevated temperatures. In this publication a condensed but sound account is given of the general, present position, and there are few microscopists interested in this field who will not benefit from its study. The papers are well illustrated by a large number of photomicrographs, and, though a few of these show too clearly from the 'screen' that they are reproductions, the general standard is good.

Cave Sites of the Mogollon Culture in New Mexico

THE finds from the cave sites of the Mogollon culture of west-central New Mexico are of no great antiquity; indeed, the earlier ones do not date before 1100 A.D. and the later group perhaps to 1300 A.D. But they are no less interesting for that, and the careful study of four cave sites, two of them containing cliff dwellings, by Paul S. Martin, John B. Rinaldo and Elaine Bluhm, has been well worth while (Fieldiana–Anthropology, Vol. 42: Pub. 731 of the Chicago Natural History Museum; pp. 227; 1954; 2 dollars). The culture of the Mogollon Indians has long been under investigation, but these are the first cliff dwellings that have been carefully dug and of which the details have been published. The caves occur in New Mexico in the Pine Lawn valley district. The excellent illustrations make it easy to follow the excavations. After describing the digs, a critical study of the pottery and other finds from the various levels follows. Several different types of arrow head were unearthed, and it is interesting to learn that certain types go with certain styles of pottery and seem to be characteristic of certain levels. This may prove to be an important check on studies elsewhere based exclusively on the pottery sequence. The volume is very well put together, and altogether constitutes an excellent piece of work.

An Actinophage for Potato Scab

A NUMBER of actinophages active against species of *Streptomyces* have already been reported. In a

recent paper, F. H. S. Newbould and E. H. Garrard have described the isolation of a phage specific for *S. scabies*, the pathogen of potato scab (*Canadian J. Bot.*, **32**, No. 3, 386; 1954). This phage was isolated from soil surrounding scab-infected potatoes. Tested against fifteen scab-producing *Streptomyces* cultures isolated from scab lesions, thirteen were lysed, one partially lysed and one was resistant. Against fifteen non-scab-producing strains of Actinomycetes, also isolated from scab lesions, thirteen were not lysed and two showed evidence of partial lysis. Tested against Actinomycetes cultures isolated from soil, the phage was less specific and the results were inconclusive. Lack of phage specificity is attributed to variation among *Streptomyces* cultures.

The Night Sky in December

Full moon occurs on Dec. 10d. 00h. 56m., U.T., and new moon on Dec. 25d. 07h. 33m. The following conjunctions with the moon take place: Dec. 2d. 16h., Mars 6° S.; Dec. 12d. 22h., Jupiter 3° N.; Dec. 21d. 15h., Saturn 6° N.; Dec. 21d. 20h., Venus 7° N.; Dec. 31d. 12h., Mars 6° S. In addition to these conjunctions with the moon, Venus is in conjunction with Saturn on Dec. 16d. 00h., Venus 0·7° N. Mercury, a morning star, rises 1h. 20m. before the sun on December 1 and draws nearer the sun during the remainder of the month; it will not be easily seen at any time during December. Venus, a morning star, rises at 5h. 40m., 4h. 40m. and 4h. 20m. on December 1, 15 and 31, respectively; its stellar magnitude varies between −4·0 and −4·3, and the visible portion of the illuminated disk between 0·08 and 0·34. It is interesting to notice that the planet becomes brighter in spite of its increasing distance from the earth—from 28 to 45 million miles during the month—the increase in brightness arising from the large increase in the visible portion of the illuminated disk. Mars is an evening star, setting about 22h. 15m. during December: stellar magnitude 0·5–0·8, and the visible portion of the illuminated disk 0·862–0·881. The decrease in brightness, in spite of the increase in the visible portion of the illuminated disk, is due to the increase in the planet's distance from the earth from 112 to 132 million miles during the month; it moves from a little north of ι Aquarii early in the month close to the constellation Pisces on December 21. Jupiter, an evening star, rises at 19h. 40m., 18h. 40m. and 17h. 25m. on December 1, 15 and 31, respectively. Its stellar magnitude, −2·1 during most of the month, becomes −2·2 towards the end, the increase in brightness being due to the planet's decrease in distance from the earth by 23 million miles; careful observation will show the westward movement in Cancer. Saturn, a morning star, rises at 5h. 30m., 4h. 45m. and 3h. 50m. on December 1, 15 and 31, respectively; it has a slow movement from α towards ν Librae, and this can be easily detected by careful observation. Occultations of stars brighter than magnitude 6 are as follows, observations being made at Greenwich: Dec. 11d. 05h. 19·4m., μ Gemi. (*D*); Dec. 11d. 06h. 0·8m., μ Gemi. (*R*); Dec. 12d. 04h. 16·9m., 56 Gemi. (*R*). (*D* and *R* refer to disappearance and reappearance, respectively.) The meteor shower during December 11–13, the Geminids, which attains its maximum about this time, will not be easily observed owing to moonlight. An annular eclipse of the moon on December 25, invisible at Greenwich, will be visible in South Africa and the southern Indian Ocean. Winter solstice occurs on Dec. 22d. 09h.

Announcements

Mr. J. R. Whinfield, a member of the Terylene Council of Imperial Chemical Industries, Ltd., at Harrogate, has been made an Honorary Fellow of the Textile Institute, in recognition of his outstanding contribution to the science and technology of man-made fibres. Mr. Whinfield is the twelfth recipient of this award.

The American Documentation Institute has presented a scroll of appreciation to Dr. Atherton Seidell, one of the founders of the Institute, for his work in establishing microfilm services, which have been of particular value to documentation centres and libraries in general. Dr. Seidell founded in 1941 the *Current List of Medical Literature*. He is also noted for his development of an inexpensive viewer for short strips of microfilm and a microfilm projector.

The Second Middleton Memorial Lecture will be given by Prof. K. Mather, professor of genetics in the University of Birmingham and director of the Agricultural Research Council's Unit of Biometrical Genetics, in the Senate House, University of London, on December 9, at 5.30 p.m. He will speak on "Fundamental Science in Agricultural Research, with Special Reference to the Development of Genetics". Admission is free, without ticket.

An exhibition of scientific books and periodicals from The Netherlands will be opened at the Science Library, Imperial Institute Road, London, S.W.7, on December 1. The exhibition will remain open until December 22.

The fifth annual meeting of the Société de Chimie Physique will be held in Paris during May 31–June 3, 1955, when the chemical actions of ionizing radiations on liquids will be discussed. Those wishing to read papers must send in the titles by December 15, 1954, and the full text by February 28, 1955, so that the papers can be printed in advance of the meeting. Further information can be obtained from the secretary-general of the Society, Prof. G. Emschwiller, École Supérieure de Physique et de Chimie, 10 rue Vauquelin, Paris 5e.

The Meldola Medal, which is the gift of the Society of Maccabæans and is normally awarded annually, is being offered for early award in 1955 to the chemist who, being a British subject and less than thirty years old on December 31, 1954, shows the most promise, as indicated by published chemical work brought to the notice of the Council of the Royal Institute of Chemistry before December 31. Communications should be addressed to the President, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1, the envelope being marked "Meldola Medal".

Sir George Beilby Memorial awards, which are considered at intervals by administrators representing the Royal Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals, are made to British scientific research workers, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy. The administrators request that their attention be directed, not later than December 31, to outstanding work of the nature indicated. All communications should be addressed to the Convenor of the Administrators, Sir George Beilby Memorial Fund, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

SCIENTIFIC CIVIL SERVICE

PROMOTION OF INDIVIDUAL RESEARCH WORKERS

SPECIAL posts have again been created this year in the Scientific Civil Service under provisions included in the White Paper (Cmd. 6679; 1945) designed to provide for the promotion of individual research workers of exceptional merit. The promotions are effective from July 1.

Deputy Chief Scientific Officers

DR. S. K. KON, who has been head of the Nutrition Department of the National Institute for Research in Dairying since 1937, has made extensive researches which have led him to be recognized both nationally and internationally as a leading authority in nutritional science. In particular, his work has covered the nutritive value of milk and milk products, methods of assay of vitamins (especially vitamin A and the B vitamins) and the synthesis of vitamins in the animal organism, and this and studies in several other fields of nutritional biochemistry have provided both new knowledge and valuable practical applications. He has been editor of the *Proceedings of the Nutrition Society* since the inception of that Society in 1944 and of the *British Journal of Nutrition* from its beginnings in 1947.

DR. H. R. C. PRATT studied chemistry at Birkbeck College, London, and, later on, chemical engineering, his Ph.D. thesis in 1951 on "Studies in Azeotropic Distillation" being based on work done during the Second World War. He held research and development appointments in industry before joining the Atomic Energy Research Establishment, Harwell, in 1949 as leader of a group investigating chemical engineering operations of special interest to atomic energy. Dr. Pratt has himself made a significant contribution to liquid–liquid extraction and for one of his published papers he was awarded, with R. Murdoch, the Moulton Medal of the Institution of Chemical Engineers last year. He is also interested in the methods of production of heavy water, and his developments in water distillation techniques have brought this method into the realm of practical economics.

Senior Principal Scientific Officers

DR. H. A. H. BOOT graduated from the University of Birmingham in 1938 and later, during the Second World War, was co-inventor, with Dr. J. T. Randall, of the cavity magnetron which established and maintained for the Allies so great an advantage in the field of radar. During 1945–48 Dr. Boot held a senior Nuffield research fellowship at Birmingham and was engaged on the design of the cyclotron. He then joined the Royal Naval Scientific Service and since then has been mainly occupied at the Services Electronics Research Laboratory in research, development and design for the manufacture of advanced types of magnetron of very high power.

MR. K. V. DIPROSE entered the Royal Aircraft Establishment in 1935 on leaving Cambridge, where he had read for the Mechanical Sciences Tripos, being awarded the J. B. Seeley Prize in Aeronautics. He has displayed outstanding scientific and design ability in several fields, including the instrumentation of wind tunnels, the aerodynamics of airscrews, early jet-engine research, analogue computing instruments and data-reduction schemes for wind tunnels. He is a leading British authority on analogue computers, and the present general recognition of the importance of a co-ordinated approach to the whole problem of the design of experiments, processing of data and computing of results, is due in large measure to his efforts during the past ten years.

MR. T. M. FRY worked on underwater detection problems for the Admiralty during 1939–45, before proceeding to the University of Cambridge. After graduating in 1947, he joined the Atomic Energy Research Establishment, Harwell, where he investigated changes in the properties of graphite and other solids resulting from exposure to the radiations in nuclear reactors. As well as its importance for the development of nuclear power, this type of work provides a new method for investigating the solid state. Since 1951 he has devoted his attention mainly to a study of the fast-breeder reactor, and in addition, since 1947, he has been associated with Mr. F. T. Bacon's hydrogen–oxygen cell research at Cambridge.

DR. E. R. R. HOLMBERG graduated from the University of Cambridge in 1939 and entered Admiralty service the following year. He was appointed to the Mine Design Department and during the next five years played a significant part in solving the many problems involved in ship demagnetization. In 1945 he was transferred to the Admiralty Gunnery Establishment, where his mathematical ability was directed to theoretical studies of missile guidance and control systems. Since 1950 he has been serving in the Department of Operational Research. In 1952 he was elected to the Geophysical Committee of the Royal Astronomical Society and has had a number of papers published in the *Monthly Notices* of the Society in which, as in his defence research work, he has shown a marked originality of outlook and incisiveness of method.

DR. D. KÜCHEMANN was engaged in aeronautical research at A.V.A. Göttingen with Prof. Betz after obtaining his doctorate at the University of Göttingen in 1936. He gained a considerable reputation there for his work on basic aerofoil theory, wind-tunnel corrections and the aerodynamics of propulsion. He joined the Royal Aircraft Establishment in 1946 in the Wind Tunnels Group, where he has made important contributions to research on swept wings and the flow about high-speed aircraft configurations, both from the theoretical and experimental aspects, which have led to a greatly improved understanding of the fundamentals of high-speed aircraft design.

MR. S. W. NOBLE joined the Telecommunications Research Establishment, now the Radar Research Establishment, at Swanage in 1940, after varied industrial experience. He was engaged on research in the radar field until 1944, when he commenced work on advanced circuit research with which his name is now prominently associated. He has made outstanding and distinctive contributions to electronic circuit design, in which field he is an acknowledged leading authority.

DR. F. PASQUILL has been mainly engaged in problems of atmospheric diffusion and turbulence

near the surface of the earth, since his appointment to the Meteorological Office in 1937. His association with the Chemical Defence Experimental Establishment, Porton, during his early years of service, was marked by a valuable experimental study of evaporation from a plane-free liquid surface into a turbulent air stream. Later, in charge of a small Meteorological Office group attached to the School of Agriculture, Cambridge, to study micro-meteorological problems with application to agriculture, he devised a method and equipment for the investigation (by the use of accurate vertical profile measurements of humidity and temperature) of the exchange of heat and water vapour between a grass-covered surface and the air immediately above. This led to a successful evaluation of evaporation from the surface. The aerodynamic drag of grassland was also investigated. Dr. Pasquill is now engaged in research on atmospheric diffusion processes on a more extended scale.

Dr. J. M. Shewan studied chemistry in the University of Aberdeen, being awarded a medal in physical chemistry in 1932, and gained his Ph.D. for work at the Macaulay Soil Research Institute. He then entered on a career in marine bacteriology and biochemistry at the Torry Research Station, where his work has included the only really detailed study of the strict anaerobes of fish, a survey of the aerobic microflora of gadoids, and the discovery that the microflora of fish varies considerably with species, locality, time of year and method of catching. In the preservation of fish he has shown how the microflora changes in composition, as spoilage proceeds, and he has made pioneering studies of the effect of phenolic substances in wood smoke in the curing of smoked fish. He is at present engaged in unravelling the taxonomic confusion which exists in the field of marine bacteriology, and on an extensive study of the extractives of fish which are the substances first attacked by bacteria. In connexion with the preservation of fish on ice, he has developed a sensory scoring system which, as a research tool, has become of great use in defining and controlling standards of freshness.

Mr. G. W. C. Taylor joined the Research Department, Woolwich Arsenal, in 1929, transferring to the staff of the Explosives Research and Development Establishment, Waltham Abbey, on its formation in 1945. His early experience was in the chemical analysis and testing of explosives, which was followed by photographic and radiological investigations. Since 1939 he has been concerned with a special class of explosives, carrying his researches from the laboratory stage to full-scale manufacture, and this has led to investigations on the control of crystallization which have given rise to practical results of the greatest value. Much of his work has been of a pioneering nature in a region hitherto unexplored because of the formidable hazards and difficulties involved.

Mr. J. H. Wilkinson graduated in mathematics from the University of Cambridge and then worked on ballistics in the Ministry of Supply for some six years before joining, in 1946, the Mathematics Division of the National Physical Laboratory, Teddington. He has worked on the design and exploitation of high-speed automatic electronic digital computers, and has been very closely associated with the theoretical design, electronics and practical use of the Laboratory's machine, the Pilot ACE. In particular, he has made a very thorough study of practical methods of calculating latent roots and vectors of matrices, which are of wide application, especially in problems of aircraft design.

Dr. H. G. Wolfhard studied physics at the University of Göttingen, gaining his doctorate in 1938, and later joined L.F.A. Volkenrode, where he worked until 1946, taking charge of a group on combustion towards the end of this period. He joined the Royal Aircraft Establishment in the same year, where he has worked in the Chemistry Department and, more recently, in the Rocket Propulsion Department in charge of the combustion section. During 1946–52 he worked part-time with Dr. A. G. Gaydon at the Imperial College of Science and Technology, London. He has been outstandingly successful in the application of spectroscopy to the study of flames and combustion processes.

WORLD POWER RESOURCES

In his presidential address given before the Institution of Electrical Engineers on October 7, Mr. J. Eccles was concerned mainly with the power resources of the world. He sketched in outline the origins of the earth's main resources of fuel, first tracing the exceedingly gradual evolution of man's use of mechanical power up to the opening of the industrial era. He then showed that, with the enormously accelerated rate of consumption of fuel which has developed during the past two hundred and fifty years, a further period of several hundred years will see the substantial exhaustion of the world's resources of coal and oil; indeed, the supply of oil fuel may well become critical during the lifetime of the present rising generation.

Dealing with other available forms of energy, apart from nuclear energy, Mr. Eccles first considered water power and tidal power. Some forty per cent of the world total of inland water power is located in Africa, and this total without, of course, regard to location, could supply at least three-quarters of the world's present energy requirements. He remarked that one of the largest and most spectacular sources of water power lies at the western end of the Mediterranean, for this inland sea loses water through evaporation at a rate exceeding its river inflow, so that water is constantly flowing through the Straits of Gibraltar and, to a lesser extent, through the Dardanelles. If both straits were dammed, the level of the Mediterranean would gradually fall, and rough calculation shows that, having established a differential of 70 ft., 12 million kW. (which is 75 per cent of the present demand for electricity in Great Britain) could be developed from suitable turbines operated by inflow from the Atlantic.

Summing up the position in regard to what may be termed the conventional sources of energy, Mr. Eccles said that, when coal and oil are exhausted, and in the absence of a successful outcome of the attempts to harness the nuclear fission or fusion process for industrial purposes, it should be possible to muster man's present-day energy requirements from all the known sources, but that energy transmission or population transportation would present enormous technical and social problems.

If the present pattern of civilization is to endure, the problems of nuclear energy must be mastered. It has been established, said Mr. Eccles, that, on the basis of present costs, an expenditure of about

£50 per pound of pure metal would be sufficient to mine and to refine sufficient uranium to provide the world's present energy requirements for some 1,500 years, or on a similar basis, an expenditure of £100 per pound could furnish these requirements for 8,500 years. The abundance of hydrogen in the earth's crust could provide almost unlimited power from the hydrogen–helium reaction, but the industrial application of this must await the discovery of means of enabling the reaction to proceed at a lower sustained temperature.

Because of the possibility of supplying the world demand for power by means of nuclear fission, it is now sometimes argued that all development effort should be applied in that direction and the development of other sources abandoned. Mr. Eccles, however, did not hold this view: when there is, for example, "a local surplus of water power, the energy could be used to purify fissile material so as to provide power in lands where the alternatives are insufficient. Since fissile material, even in its natural state, is easily transportable, such packaged fuel might solve the power transmission problem".

Finally, Mr. Eccles referred to the minute fraction of existence of the human race within which this tremendous demand for power has developed, and he emphasized the paramount necessity to match, by means of continued technological advancement, the world's progressive demands for the basic necessities of food and fuel. "In sum, therefore, man having evolved during a million years has, over the past 250 years, developed a mode of living which is unique in human history. This achievement has thus lasted for only 0·025 per cent of his sojourn here and already it has made great demand on the energy resources of our planet. Unless he is able and willing to match his technology to the unfolding needs of the situation, he has no prescriptive right to a continuance of this latest civilization, and the history of civilizations discloses that discontinuity—decay and rebirth—is the normal method by which successive stages have been reached. However, to-day man is equipped with a knowledge of natural laws (science) and an ability to harness these laws to his needs (engineering) that were absent in all previous civilizations, and there is good reason for thinking that the present mode of living can be greatly prolonged if he will but use this knowledge and ability aright."

AIRCRAFT ELECTRICAL SYSTEMS

A VACATION school on "Aircraft Electrical Systems" was held in the Electrical Engineering Department of the Imperial College of Science and Technology, London, during September 20–24 and was attended by nearly seventy engineers drawn from electrical and aircraft industries, research organizations and the College of Aeronautics, Cranfield. The purpose of the school was to bring out the scientific principles underlying the design and application of all forms of equipment used in aircraft electrical systems, in relation to both present and future requirements. The course was very successful, particularly since those who participated contributed a large part to the discussions. The conclusions drawn were that more co-operation is needed between design and installation engineers and that, notwithstanding the special conditions of aircraft work, much can be learned from ordinary industrial practice; educational work was also stressed, particularly the part being played by Imperial College.

In his opening address, Sir Frederick Handley Page emphasized the importance of fundamental research in that it often leads ultimately to useful practical results. After directing attention to electrical and aeronautical engineering as the two newest branches of the art, he referred to the interesting problems which have arisen as they have progressively come together, and to the need for closer liaison between members of these two branches. In an introductory survey, D. F. Welch (British Thomson-Houston Co., Coventry) outlined the problems facing the aircraft electrical engineer. Since 1940 power requirements have risen from 1 kW. to 200 kW. for large aircraft, and with these powers the potentially destructive power of a fault has focused fresh attention on circuit protection. The avoidance of any breakdown is doubly important in that the introduction of power-operated controls and the electrical operation of essential flying instruments mean that the safety of an aircraft is now dependent on the maintenance of the electrical power supply. M. Hancock (Royal Aircraft Establishment, Farnborough), speaking on environmental conditions and functional requirements, pointed out that these lead to acute differences between aircraft and ground-based electrical engineering practice: operation at high altitude increases arcing problems in switchgear and decreases machine cooling, while the wide temperature-range over which the equipment must function increases insulation and lubrication problems. Mechanical problems, vibration, weight and bulk considerations are all factors with special problems in relation to aircraft. In the third lecture, J. H. Rea (Rotax, Ltd.) dealt with power systems, and discussed the factors which determine the choice of system, methods of load analysis which distinguish between 'safety' and 'comfort' loads, and methods of weight analysis which lead to the lightest installation capable of supplying the load. The place of the battery, with particular reference to the problem of engine starting, was also considered.

The more specialized lectures given at the course commenced with that of R. F. Sims (Farnborough), who first discussed the physical causes of the abnormal brushwear experienced at high altitudes, outlining remedial measures such as the use of special materials or the control of the moisture content of the machine-cooling air, and then in the second part of his lecture considered vibration problems. After a general survey of cooling problems, Dr. C. S. Hudson (Farnborough) reviewed the effects of radiation, natural and forced convection, and conduction, and discussed methods of calculating the pressure head required in a cooling system. The topic of d.c. machines was covered in the next lecture by B. Adkins (Imperial College, London), who showed how machines must be compactly constructed in order to obtain the output required with minimum weight. He also pointed out how the insulation, the methods of connecting and securing the windings, and the grease used for lubrication, all set a limit to the permissible temperature rise.

On September 22 the members of the course visited the works of Vickers-Armstrong, Ltd., at Weybridge, including the company's Electrical Laboratory and the Research Department, and the seventh lecture, on electrical installation engineering, by H. Zeffert (Vickers-Armstrong), was partly a com-

mentary on the visit, for Dr. Zeffert described and demonstrated many types of plugs, sockets, terminal blocks and cables. The main run of lectures was continued on the next day with one on a.c. machines by W. Philipp (Rotax, Ltd.), who discussed the problems of alternator design, both for the long speed-range machines now in use and for the constant-speed machines which will be required when a constant-speed drive, taken either from an engine-driven hydraulic gear or from a separate turbine, becomes available; he also spoke on conversion equipment, using invertors, rotary transformer or motor-alternators, and on induction motors. From machines the programme of the course turned to system operation and protection, in which K. J. Payne (British Thomson-Houston Co., Coventry) considered power system maintenance, servicing the system or correcting faults being, of course, impossible during actual operational use. After a general discussion on the limits of operation of the components of a typical system and their effects on system performance, and also protection techniques, Mr. Payne described the transient behaviour of inverters and motors and the effects of electrical and mechanical shock loads. The theme of A. Grieve's (British Thomson-Houston Co., Coventry) lecture was switchgear, the factors involved in the design of switches, and the limitations imposed on performance by the fundamental properties of the materials and of the environment in which they are to operate; in discussing the characteristics required of a circuit breaker, he said that protection against most forms of fault can be incorporated in any unit of switchgear.

In the concluding survey, in which he discussed future trends, S. F. Follett (Ministry of Supply) stated that future aircraft will fly faster and higher, so that environmental changes will most influence future practice; he felt that the need for reliability should be stressed, and that reliability should be proved on life-tests which approximate to aircraft conditions and allow for the effect of vibration.

MARINE BIOLOGY IN LATIN AMERICA

DURING September 15–17 a group of Latin American specialists in marine biology met in Concepción (Chile) in order to study the possibility of establishing an international network of marine biological laboratories in Latin America and other ways of facilitating the collaboration in this field among the Latin American countries. The meeting was convoked by the Unesco Science Co-operation Office for Latin America and was a sequel to the recommendations for setting up international and regional laboratories made at a meeting held in Montevideo in 1952 upon the initiative of the Unesco Office (see *Nature*, **170**, 605; 1952). The scientists attending the meeting were from the Argentine, Brazil, Chile, Cuba, Mexico, Peru, Venezuela and Uruguay. The Regional Office in Santiago de Chile of the United Nations Food and Agriculture Organization collaborated in arranging the meeting.

After studying the present situation of research in marine biology in Latin America and its future possibilities, the delegates entered on an extensive discussion about the possibilities and ways of establishing an international network of laboratories. It was unanimously decided to create immediately under the auspices of the Unesco Science Co-operation Office a Latin American Committee in order to co-ordinate and facilitate the research work in marine biology. The Committee would remain in office until a permanent organization had been set up. The meeting requested the Unesco Office to prepare a draft convention for an international network of laboratories and convoke a meeting of official delegates in order to establish the corresponding organization.

The meeting also studied what other steps could be taken immediately pending the realization of the more far-reaching recommendations, in order to promote research in marine biology, and advised the Unesco Office that two training-courses on the methodology of marine biology research and a symposium on plankton should be organized in 1955. It was also recommended that the *Marine Biology Journal*, produced by the Montemar Station in Chile, should be widened in scope with a Latin American editorial board.

The Brazilian representatives to the meeting have been duly authorized by the Governor of the State of São Paulo to put at the disposal of the Unesco Science Co-operation Office for international research work the complete network of marine biological laboratories and stations and research vessels of the State of São Paulo. This offer will make it possible to initiate shortly international research and training programmes in marine biology under the auspices of the Unesco Office.

UNITED NATIONS ORGANIZATION

ANNUAL REPORT OF THE SECRETARY-GENERAL FOR 1953–54

THE ninth annual report of the Secretary-General of the United Nations to the Member States on the work of the Organization during July 1, 1953–June 30, 1954* is not an encouraging document. It gives a picture of diversity of effort which closely matches that to be found in the reports on the work of the League of Nations, and, as with that organization, it is in the technical fields that progress is most marked. Elsewhere, and above all in the political field, the gap between purpose and achievement is wide; nor does it appear that all Member States are concerned to advance the declared purposes of the United Nations. The Secretary-General comments on the need for a careful balance in the development of regional arrangements outside the framework of the United Nations. Choice of such arrangements for the maintenance of peace should not be permitted to cast doubt on the ultimate responsibility of the United Nations, or to impair the right of a Member State to a hearing under the Charter.

Referring to the lack of progress in disarmament, the Secretary-General comments on the potentialities of the development of an international partnership, open to all nations, in the use of atomic energy for peaceful purposes, especially for the economically

* United Nations. Annual Report of the Secretary-General on the Work of the Organization, 1 July 1953–30 June 1954. (General Assembly—Official Records: Ninth Session. Supplement No. 1 (*A*/2663).) Pp. xv+120. (New York: United Nations; London: H.M.S.O., 1954.) 1.25 dollars; 9*s.*; 5 Swiss francs.

under-developed areas of the world. Apart from recording President Eisenhower's statement of December 8, 1953, the report makes no other reference to the use of atomic energy for peaceful purposes. The report also puts on record the opinion of the United Nations Commission on the racial situation in the Union of South Africa that the doctrine of racial superiority, on which the apartheid policy is based, is scientifically false, extremely dangerous to internal peace and international relations, and contrary to the dignity and worth of the human person; but the report is so careful to give both sides of the case, and to avoid giving offence, that it presents a picture of frustration which, while it may exceed the reality, completely bewilders the ordinary reader.

It is a relief to turn to the chapters of the report which deal with economic and social questions where, by and large, the United Nations is carrying on so much that was begun under the auspices of the League of Nations. In the field of narcotic drugs, 6-methyl-Δ-6-deoxymorphine and its salts and five synthetic narcotic drugs have been brought under control, and a new list of factories manufacturing narcotics has been completed on the basis of information supplied by governments and will be published shortly. A programme of studies on the cultivation and wild growth of the cannabis (Indian hemp) plant, the production, licit and illicit distribution and consumption of drugs from it and their control has been approved, and papers on synthetic substances with morphine-like effects and on addiction-producing effects in relation to chemical structure have been prepared, while a programme of scientific research on opium continues to be pursued.

On the Expanded Programme of Technical Assistance for the economic development of under-developed countries, the report adds little to recent reports (see *Nature*, November 20, p. 960). Reference is made to the easing of financial management which resulted from the holding of the pledging conference before the beginning of the year, but financial resources are still inadequate to meet all the requests received. Of the 23·5 million dollars earmarked for expenditure in 1953, 18·1 per cent was for health services and 7·7 per cent for educational purposes, including research. For 1954, 75 per cent of total resources, excluding carry-overs, will be automatically available for allocation to the participating organizations, but the system of allocation for future years is under review. Commenting on the regular programme of technical assistance, the report notes that technical assistance has become an accepted means of international co-operation and has been instrumental in changing the climate of opinion in international affairs. More intensive use of its possibilities has been assisted by a better-defined conception of technical assistance in most recipient countries, and in a measure the success of technical assistance projects is indicated by the increase in their average duration. In discussing the development of public understanding generally, the Secretary-General suggests that the Technical Assistance Programme has been an important factor in the growth of public understanding at least of the non-political work of the United Nations during the past twelve months. It is clear that much remains to be done, though the means by which such educational work is best effected calls for further discussion than is possible in the present report. There are some sound comments on the role of the Secretariat; but while the Secretary-General rightly insists that there are limits to the work which can be entrusted efficiently and effectively to a Secretariat of any given size, and even to the amount of work which can usefully be undertaken by an international organization not circumscribed by such limits, his references to the question of staff loyalty and independence on which the smooth functioning of an international civil service fundamentally depends are purely factual and fail to bring out what is at stake.

ORIGINS OF THE INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

IN the 1954 Year Book of the International Council of Scientific Unions*, the secretary-general, Prof. A. V. Hill, contributes a valuable account of the origins of the Council. In the latter part of the nineteenth century a number of international scientific organizations were started. Some were to advance science by direct co-operation. Others were to facilitate personal acquaintance and interchange of opinion; international scientific congresses held periodically are in this class. Others aimed at establishing uniformity of standards of measurement, and of these the earliest was the Bureau International des Poids et Mesures, which was established at Sèvres in 1873 as the outcome of an international commission set up in 1869 for the construction of metric standards.

For some years before 1898 the Academies of Munich and Vienna, with the Royal Societies of Göttingen and Leipzig, had met annually as an association to discuss matters of common interest. In 1898 the meeting was to be held in Göttingen, and the Royal Society of Göttingen invited the Royal Society of London to take part; the latter agreed to join the association if its scope was so extended as to assume a fully international character. In 1918 the Royal Society, the Academy of Sciences in France and the National Academy of Sciences in the United States discussed informally the future organization of scientific undertakings which had been carried on before the First World War by international co-operation; ultimately the academies of all the Allied countries were invited to send representatives to a conference which took place in London in October 1918. This was followed by a meeting in Paris a month later, when an executive committee was appointed to draft the statutes for an International Research Council which, with a number of affiliated International Unions, might deal with matters of international scientific interest. A General Assembly of this Council was held at Brussels in July 1919, when the statutes of the Council were approved. International Unions for Astronomy, Geodesy and Geophysics, Chemistry and (shortly after) Mathematics were formed: and to these were later added Scientific Radio, Physics, Geography, Biological Sciences, Crystallography, Theoretical and Applied Mechanics, History of Science, and Mathematics (reconstituted in 1952).

At the start, the International Research Council retained control over the Unions and only allowed countries to join the Unions which already adhered to the International Research Council. Differences

* The Year Book of the International Council of Scientific Unions, 1954. Pp. ii+82. (London: International Council of Scientific Unions, c/o Royal Society, 1954.)

of opinion about this and other matters led to a reorganization in 1931, by which the Council was transformed into the International Council of Scientific Unions. Under the new arrangement the Unions became autonomous within the framework of the new Council, the General Assembly was permitted to meet elsewhere than in Brussels, and adherence of a country to any Union no longer required adherence to the Council.

In 1946 the United Nations Educational, Scientific and Cultural Organization (Unesco) was formed and a formal and mutual draft agreement between Unesco and the International Council of Scientific Unions was approved by the Council in 1946 at its first General Assembly after the Second World War. This agreement was modified in 1947 and again in 1952. The present agreement is described in the year book of the Council, which also contains details of members of the various councils, statutes and rules, the activities of the Council and the state of its finances.

WEIGHING IN THE LABORATORY

THE principles of the design, adjustment, use and testing of good-quality knife-edge balances and weights employed for precise weighing in scientific laboratories forms the subject of the seventh in the series of "Notes on Applied Science" issued by the Department of Scientific Research*. The information given, which is based largely on the experience gained at the National Physical Laboratory, Teddington, in maintaining the standards of mass and in testing weights and balances, should be of great value to those in industry and research who are concerned with precise weighings.

The contents, which are in two parts dealing respectively with knife-edge balances and weights, are much more detailed than in previous numbers of the series and include illustrations of the precision 1-kgm. balance at the National Physical Laboratory which is used for the comparison of national standards of mass, of the Imperial Standard Pound and the British National Copy of the International Kilogramme, and several tables and three appendixes. In Part 1 the chief features—functioning and adjustment of the simple equal-arm balance—are outlined clearly and fully with particular emphasis on the essential practical requirements. Various types of balance are discussed, and comparative information is summarized in two useful tables. The methods and technique of weighing are described, and net buoyancy corrections to obtain mass from weighings in air, and values of the density of air for the ranges 5–30° C. and 600–800 mm. of mercury are tabulated. A clear distinction is drawn between the conceptions of sensitivity and accuracy of performance of a balance, and a guide is given to the varieties of balances readily available.

In Part 2 the suitability of the various materials used for the construction of weights is considered first. Plain polished brass is unsatisfactory; and, of the coating materials, lacquer is too hygroscopic, uncoated nickel plating fogs and gold plating is often porous and is also liable to loss of weight due to wear. The construction, adjustment and tolerances are discussed next, followed by a brief description of the tests and methods of verification of weights carried out at the National Physical Laboratory, which will be of considerable interest to those who are contemplating sending weights for test at the Laboratory or who intend to carry out their own tests.

In the three appendixes, the simple fundamental analysis of the equal-arm undamped knife-edge balance substantially as given in Glazebrook's "Dictionary of Applied Physics", the mathematical discussion of the motion of the damped beam, and the effect of air-buoyancy on a single-pan balance are given separate treatment.

* National Physical Laboratory Notes on Applied Science. No. 7: Balances, Weights and Precise Laboratory Weighing. Pp. iv+42+plates. (London: H.M.S.O. 1954.) 2s. net.

AGES OF URANINITES BY A NEW METHOD

By Dr. B. WASSERSTEIN
Geological Survey, Pretoria

IN a previous communication in *Nature*[1], I suggested that the generation by radioactive decay of smaller atoms of tetravalent lead within the crystal lattice of uraninites caused a shrinkage in the unit cell proportionate to time; some preliminary results were given in a table. Using artificial uranium oxide (UO_3) as an end-point to denote zero time, four results clearly supported the thesis; but three others, agreeing well among themselves, were apparently too high and in conflict. Further work has indicated an obvious solution, namely, that there are, in fact, two different types of uraninites involved: those agreeing with the thesis I call α-uraninites and are considered normal; those which are apparently anomalous are called γ-uraninites.

The pitchblendes are classified as β-uraninites. As their spectra are usually too poor for accurate measurement, they are for the moment disregarded for age determination. Present work indicates that they are abnormally high in oxygen; this excess can be removed by heating in hydrogen to give cube-edges comparable with α-uraninites for purposes of age determinations; these results will be shortly announced.

The characteristic feature of γ-uraninites is that their cube-edges are reduced on heating in air to correspond to that of an α-type analogue, whereas α-uraninites upon similar treatment disintegrate to give an X-ray pattern of U_3O_8. This phenomenon was first detected in two analysed samples, previously given as from Namaqualand, but more accurately, from the Gordonia district, South Africa[1]. In presenting the data, a thoria correction—also discussed previously—has to be applied, and this is −0·0013 A. for each per cent ThO_2 when $ThO_2 + UO_2$ total 100 per cent—this suffices for a first approximation. The thoria content differs slightly in the two samples, which gave the following results:

	Gordonia	
	(Holmes) γ-type	(Mountain) α-type
Untreated	5·485 A.	5·444 A.
Corrected for ThO_2	5·462 A.	5·428 A.
Heated	5·450 A.	(disintegrates)
Corrected for ThO_2	5·427 A.	

The agreement now in the cube-edges derived from Holmes's heated sample, namely, 5·427 A., and Mountain's untreated one, which is 5·428 A., is remarkable—but not unique: similar results have been encountered from Brazil and Norway:

Boqueirao, Brazil (*ex* Harvard Coll.); untreated	5·481 A. (γ-type)
As above after calcination	5·449 A.
Same locality (*ex* Marble); untreated	5·445 A. (α-type)
Moss, Norway; untreated	5·488 A. (γ-type)
As above after calcination	5·449 A.
Satersdalen, Norway; untreated	5·450 A. (α-type)

The results agree within the limits of error in the determinations.

When γ-types are weathered, commercial nitrogen, which contains a little oxygen, serves to reduce the cube-edge and to differentiate between α- and γ-types; β-types are recognized by an increase in cube-edge when heated in hydrogen. These manipulations are necessary when the chemical differences of the three types of uraninites become apparent.

It is clear that each of the three types forms its own series showing shrinkage with time. The X-ray examinations of numerous uraninites, before and after heating, support this supposition; but the lack of accurate age determinations is a handicap in checking such results. In developing the present X-ray method, it is found preferable in practice to use results from heated γ-uraninites together with untreated α-uraninites, as generally the α-type is concentrated in the lower ages.

This classification of uraninites into three types can be deduced from certain laboratory studies of the uranium oxides, although total agreement among investigators may not have been reached. The relevant data have been largely assembled by Katz and Rabinowitch in their comprehensive text-book[2]. In dealing with the range $UO_{1\cdot75}$–$_{2\cdot3}$, Zachariasen[3], Jolibois[4] and Alberman and Anderson[5] have made valuable contributions.

Jolibois provides evidence for the possible compound $UO_{2\cdot33}$ which he ". . . interpreted . . . as a new uranium oxide U_3O_7 (or $UO_3.2UO_2$)"[3], and Alberman and Anderson prepared ". . . two well defined cubic phases, viz. UO_2 and a phase of composition close to $UO_{2\cdot5}$ ('β-UO_3 phase')"; further oxygenation gave them a tetragonal phase. At the other extreme, "Zachariasen found a homogeneous face-centered cubic phase with a composition of approximately $UO_{1\cdot75}$ (or U_4O_7, tetrauranium heptoxide) . . . U_4O_7 may be a separate compound analogous to Th_4S_7"[2]. There is therefore considerable evidence for three oxides of uranium in the range discussed here, and these three are characterized by a fluorite structure with different parameters, namely:

$UO_{1\cdot75}$ (possibly U_4O_7)	5·488 A.
UO_2	5·470 A.
$UO_{2\cdot33}$ (possibly U_3O_7)	5·440 A.

(A confusion of A. with kX-units seems to exist in the data presented by Katz and Rabinowitch.)

Uraninites are thought to fall in the range given above, and the analogy in the laboratory is suggested to account for the threefold classification of the uraninites in this way:

γ-uraninites correspond to U_4O_7 ('γ-UO_2' ?)
α-uraninites correspond to UO_2
β-uraninites correspond to U_3O_7 ('β-UO_2').

With this classification and the thesis of tetravalent lead generation, a fine order can be brought into the apparently chaotic data on cube-edges. My investigations over a period of years on uraninites support this classification in several respects. All uraninites, after allowance for thoria, have cube-edges less than 5·488 A., and this indicates that no uraninite lies in the range $UO_{1-1\cdot75}$—where also no laboratory product exists. Three separate age-series can be recognized corresponding to the three oxides given above, using their cube-edges as criteria; and in these all α-uraninites, and all but possibly one β-uraninite, have cube-edges less than 5·470 A. and 5·440 A. respectively. As suggested in the classification, γ-uraninites require oxidation, whereas β-uraninites require reduction in order to compare their cube-edges directly with those of α-types.

Differential thermal analysis evidence was obtained upon my suggestion: an α-uraninite (Rhokana Mine) differed from a γ-uraninite (Gordonia). The latter showed a gentle exothermic curve[6] which is in harmony with oxidation of $UO_{1\cdot75}$ to UO_2.

X-ray studies of thorianites are also illuminating, as here no hexavalent state of thorium can contribute to the shrinkage of the unit cell. All thorianites belong to the γ-type and therefore suggest, in analogy to U_4O_7, the oxide Th_4O_7. Although this oxide is apparently not yet known, Th_4S_7 has been prepared and suggests its possibility. In that event thorianites may well be regarded as the equivalent of Th_4O_7 rather than ThO_2.

The amazing coincidence that three compounds closely related chemically should at the same time yield almost identical X-ray patterns has prevented the recognition of the close parallel in Nature where analogous differences exist in the uraninites. Many chemical and mineralogical differences now find a more ready explanation.

Table 1

Sample	Type	Isotope age	Cube-edge (corrected for thoria)
UO_2	α	Zero	5·470 A.
Connecticut, U.S.A.	α	250 m.y.	5·463 A.
Belgian Congo	α	620 ,,	5·448 A.
Bisundni, India	α	735 ,,	5·443 A.
Gaya, India	γ	955 ± 40 m.y.	5·436 A.
Wilberforce, Canada	γ	1,035 ,,	5·432 A.
Gordonia, S. Africa (Mountain)	α	1,025 ,,	5·428 A.
Gordonia, S. Africa (Holmes)	γ	1,025 ,,	5·427 A.
Witwatersrand, S. Africa	γ	2,000 ,, (ref. 7)	5·400 A.

The previously published table has been amended and corrected to give the results in Table 1, to which for the sake of interest and completeness the Witwatersrand value has been added to show the continuation of the shrinkage with time up to 2,000 million years. [Aug. 27.

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ESTIMATES OF AGE FOR SOME AFRICAN MINERALS

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ABOUT two hundred radiogenic and ore leads from Canadian Precambrian minerals and a few potassium-bearing feldspars and micas have been analysed and dated at the University of Toronto. The results have been published[1–3] or are in the press[4]. Intercomparisons are being made with other laboratories[5]. These and other earlier age determinations have led to new interpretations of the structure of the Canadian Shield[6–11].

To test these conclusions for other continents, forty-five African minerals and a few from other continents have been analysed. The results for Africa are given here so that they can be compared with African geology by those acquainted with its details. These ages appear to agree well with those for uranium, thorium and lead minerals from Africa already published by Nier[12,13], Holmes[14–17], Ehrenberg[18] and Geiss[19]; but their relation to the results of Wasserstein[20] and Davidson[21] need further investigation. The rubidium–strontium method of age determination still appears to be in a state of development[22–24].

Our experience suggests that the following general conclusions about age determinations and continental structure may be tenable.

(*a*) We agree with Nier and Holmes that the ages obtained for uranium minerals are the most reliable when concordant ages are obtained by both chemical and isotopic analyses. This is the case for the monazite from Bikita, Southern Rhodesia[17]. Such results and preliminary measurements by R. D. Russell (unpublished results) suggest that radon loss does not appreciably affect age determinations by the lead ratio ($^{207}Pb/^{206}Pb$) method for old, fresh, uranium minerals, although it can lead to large errors in age determinations for young and altered minerals.

(*b*) Ages calculated from the argon–potassium ratio ($^{40}A/^{40}K$) for potassium-bearing feldspars and micas are in agreement with those obtained by the above methods. A value of 0·089 for the branching ratio of potassium-40 has been used to calculate the argon–potassium ages. This branching ratio was obtained by using radiogenic argon measurements carried out independently at two different laboratories[25,26].

(*c*) Isotopic analyses of many old lead ores can be used to date them[3,27]. The ages agree with those determined for apparently contemporaneous uranium and thorium minerals. It is considered that this method can be made still more precise, and that the curves used for dating them[27] may be modified. The ages given in Table 1 are therefore tentative.

(*d*) Vein minerals, including galena, give only minimum ages, and, unlike pegmatites, may be very much younger than the surrounding country rocks.

(*e*) All minerals more than about 2×10^9 years old have been found to come from areas underlain by rocks of Keewatin and Timiskaming types and by granites cutting them. Such areas are already known and dated in or around Ontario; Yellowknife, North West Territories; Uganda–Kenya; Southern Rhodesia; Transvaal–Swaziland; Sierra Leone; North Belgium Congo; Mysore, India; Kalgoorlie, Australia, and perhaps in the Sveco-Fennidian area. They are regarded as continental nuclei. They have a different type of structure and petrology from later belts, a higher proportion of lavas, and they may have been formed when temperatures in the earth were higher than in more recent times.

(*f*) All Archean-type rocks younger than about 2×10^9 years old form belts, each of which is marked by pegmatites formed during a limited range in time; they are markedly gneissic; they do not

Table 1. Isotopic Ratios and Estimates of Age for Galenas

No.	Tor. No.	Location	Lead-206 / Lead-204	Lead-207 / Lead-204	Lead-208 / Lead-204	Age in 10^6 yr.	Source
1	193	Rosetta Mine, Barberton, S. Africa	12·65	14·27	32·78	2,860 ± 60	1
2	616	Kokosho Mine, N. of Bondo, N. Belg. Congo	12·81	14·39	32·84	2,790 ± 90	2
3	593	Midland Farm, Belingwe, S. Rhodesia	13·62	14·95	33·67	2,450 ± 120	3
4	392	Vein in Kambui schists, Sierra Leone	14·01	15·15	34·37	2,260 ± 120	4
5	592	Leopard Mine, Lower Gwelo, S. Rhodesia	14·02	15·10	34·14	2,270 ± 120	3
6	395	Risks Mine, Kakamega, Kenya	14·05	15·05	34·21	2,220 ± 130	3
7	393	Borderland Mine, Busia, Uganda	14·05	15·10	34·24	2,220 ± 130	3
8	596	Wanderersrest Mine, S. Rhodesia	14·06	14·99	33·68	2,300 ± 130	3
9	500	Vein cutting Masaba Granite, Uganda	14·15	15·21	34·20	2,200 ± 120	5
10	594	Dona West Mine, Umtali, S. Rhodesia	14·40	15·45	34·39	2,100 ± 160	3
11	191	Doornhoek, Marico Distr., S. Africa	15·19	15·50	35·28	1,740 ± 200	1
12	396	Copper Queen Mine, S. Rhodesia	15·39	15·50	35·17	1,660 ± 200	3
13	615	Zambula Mine, Kibali, N.E. Belg. Congo	16·18	15·63	36·06	1,250 ± 260	2
14	188	Stavoren, Groblerstal Dist. S. Africa	16·19	15·53	36·31	1,220 ± 260	1
15	189	Groenvlei, Potgietersrust Dist., S. Africa	16·26	15·89	36·64	1,170 ± 270	1
16	622	Lubi Camp, Kasai, Belgian Congo	17·52	15·86	37·73	*	2
17	621	Near Kamituga, Kivu, E. Belg. Congo	17·78	15·85	37·53	*	2
18	373	Abenab, S.W. Africa	17·96	15·88	38·69	*	6
19	197	Bamba Kilenda, Lower Congo	18·14	15·92	38·48	*	2
20	623	Mt. Homa, Ituri, N.E. Belg. Congo	18·18	15·92	38·33	*	2
21	198	Hapilo, Lower Congo, French Equat. Africa	18·22	15·98	38·54	*	2
22	196	Kengere, S. Katanga, Belg. Congo	18·22	15·91	38·27	*	2
23	394	Broken Hill, N. Rhodesia	18·25	15·97	38·92	*	3
24	624	Mulungwishi, S. Katanga, Belg. Congo	18·26	15·87	38·49	*	2
25	625	Tsumeb Mine. S.W. Africa	18·32	15·88	38·66	*	3
26	617	La Mia, near Matadi, Lower Congo	18·32	15·84	38·01	*	2
27	618	Kisinga, near Muika, N. Katanga B. Congo	18·35	15·96	38·06	*	2
28	192	E. Geduld Mine, Witwatersrand, S. Africa	18·48	16·32	35·00	Anomalous†	1
29	190	Langlaagte, Pietersburg Dist., S. Africa	18·51	16·33	39·29	*	1
30	195	Kipushi, S. Katanga, Belg. Congo	18·52	15·97	38·38	*	2
31	597	Kitaka Mine, N.W. of Mbarara, Uganda	19·67	16·40	38·51	Anomalous	3
32	619	Up. Fungwe Riv., Centr. Katanga, B. Congo	20·48	16·11	38·87	Anomalous	2
33	163	Witwatersrand, S. Africa (ref. 2)	58·94	24·10	40·19	Anomalous†	7

* These ratios indicate ages younger than 800 million years which cannot at present be precisely dated by this method.

† The lead-208/lead-204 ratio for No. 28 indicates an age between 1,500 and 2,000 million years, but since it appears that radiogenic lead-206 and lead-207 have been added in anomalous amounts to it and in much larger amounts to No. 33, this age cannot be regarded as certain.

Table 2. Isotopic Ratios and Estimates of Age for Radiogenic Leads

No.	Tor. No.	Location	Mineral	Measured abundances 204	206	207	208	Radiogenic abundances 206	207	208	207/206 in %	Age in 10^6 yr.	Source
1	397	Pope Mine, Salisbury, S. Rhodesia	Microlite	0·26 ±0·03	73·85	15·19	10·72	70·37	11·35	2·01	16·13 ±0·50	2,510±100	3
2	162	Witwatersrand, S. Africa	Uraninite	0·05 ±0·008	84·78	11·57	3·61	81·83	10·37	1·60	12·67 ±0·50	2,070±100	7
3	497	Voandelaka, Madagascar	Euxenite	0·14 ±0·005	73·95	6·53	19·40	71·52	4·36	14·18	8·08 ±0·12	645± 60	8
4	112	Kalongwe, Belg. Congo	Pitchblende	0·035 ±0·115	93·90	5·76	0·32	93·76	5·62		5·99 ±0·04	615± 20	2
5	543	Sierra Leone, B.W. Africa Lat. 8° 49′ N., Long. 11° 48′ W.	Monazite (alluvial)	0·047 ±0·005	9·24	2·51	88·20	8·59	1·81	86·61	21·0 ±3·0	2,930±200	4

Six other isotopic analyses of radiogenic leads from Shinkolobwe have already been published by us (refs. 2, 32). The range of ages, 612–655 × 10^6 years, agrees with Nier's results. These age values have been calculated using the constants: $(^{238}U) = 0{\cdot}153(7) \times 10^9$ yr.$^{-1}$; $(^{235}U) = 0{\cdot}972(2) \times 10^9$ yr.$^{-1}$; $^{238}U/^{235}U = 137{\cdot}8$.

Table 3. Argon–Potassium Ratio and Estimate of Age for a Potassium-bearing Mineral

No.	Toronto No.	Locality	Mineral	Argon-40 / Potassium-40	Br. ratio	Age in 10^6 yr.	Source
1	1,084 (A)	Pope's Claim, Salisbury, S. Rhodesia	Lepidolite	0·269	0·089	2,610	3

Sources of Specimens listed in Tables 1, 2, and 3

(1) L. T. Nel, director, Geological Survey of South Africa, Pretoria.
(2) L. Cahen, Musée Royal du Congo Belge, Tervuren, Belgium.
(3) A. M. Macgregor, director (retired), Geological Survey of S. Rhodesia, Salisbury.
(4) N. W. Wilson, Geological Survey of Sierra Leone, Freetown.
(5) K. A. Davies, Uganda Development Corp., Ltd.
(6) J. G. Dennis, Department of Geology, Columbia University, New York.
(7) C. F. Davidson, Geological Survey of Great Britain, London.
(8) Ward's Natural Science Establishment, Rochester, N.Y.

contain a high proportion of lavas and they resemble the cores of young primary mountains. The Mozambique belt is an example (0·5–0·7 × 10^9 years old). These gneissic provinces and young mountains both form broad belts lying beside or between continental nuclei and become progressively younger at greater distances from the nuclei (for example, Keewatin nucleus, Grenville gneissic belt and Appalachian Mountains of eastern North America).

(*g*) We agree with Leith[28], who recommended that the names Archean and Proterozoic should be used for "types of rocks not time", for we find that the maximum known age of some belts of Archean gneisses is much less than the minimum age of some Proterozoic-type rocks in other places. For example, the Archean-type Grenville belt contains many pegmatites all much younger (0·8–1·1 × 10^9 years) than the veins which cut the flat-lying Proterozoic-type rocks at Martin Lake, Saskatchewan (1·6 × 10^9 years). There seem to be similar circumstances in Africa.

(*h*) It is considered that the sialic blocks of the continents have been built entirely in geological time, for even the present rate of extrusion of lava, which has been estimated[29] to be 1 km.^{3} per year, would have sufficed to build the continents in about 4 × 10^9 years. The work of MacGregor[30] and of Ewing[31] in the West Indies shows that the lavas there are predominantly acid and are rising from the depths through a basaltic ocean floor to form new additions of continental composition at the earth's surface. This appears to be the commonest type of volcanic process.

We wish to thank the geologists named for supplying the specimens and for their advice and interest. F. Dixey, A. Holmes, J. D. Louw, B. F. J. Schonland and E. S. Willbourn have also been very helpful. Additional samples to yield at least 15 mgm. of lead or consisting of a few hundred grams of potassium-bearing minerals would be welcomed.

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LETTERS TO THE EDITORS

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The Positive Column of High- and Low-Current Arcs

Transitions from a diffuse to a concentrated positive column have been observed to occur in electrical discharges in hydrogen as the current is increased[1], and a similar transition occurs from the 'low-current' to the 'high-current' carbon arc in air[2a,d]. As a result of a wide investigation of arcs in these and other gases, a purely thermal theory of these transitions has been developed, in contrast to the suggested explanation based on the magnetic pinch effect[2a,3]. A development and numerical integration of the equation of energy balance for the positive column of the arc after the manner of Brinkman[4] has enabled the radial temperature distribution for different central temperatures, and the variation of central temperature with current, to be calculated. In this the characteristic relationship between the temperature and the thermal conductivity, including the contributions of the classical kinetic theory and of the diffusion of ionized and dissociated pairs, which has been studied by a number of authors[2b,4–6], is of paramount importance. The data for nitrogen are illustrated in Fig. 1. The two maxima of the thermal conductivity at about 7,000° K. and 14,000° K. result from the dissociation and ionization of the gas respectively. In diatomic gases, the 'low-current' arc exists with central temperatures corresponding to the positive slope to the first maximum of the thermal conductivity–temperature curve, and the development of the concentrated core of the 'high-current' arc occurs in the region of negative slope, that is, between 7,000° and 9,000° K., for the arc in air or nitrogen.

The two relationships referred to above are both very similar for air and nitrogen at temperatures above 5,500° K., but have only been completely calculated for arcs in nitrogen. Figs. 2 and 3 show that good agreement between theory and observation is obtained in both cases, if Gaydon's value[7] of 9·76 eV. is adopted for the dissociation potential of N_2; the previously accepted value of 7·46 eV. does not show this agreement, and in the past has led to mistaken views as to the nature of the phenomena.

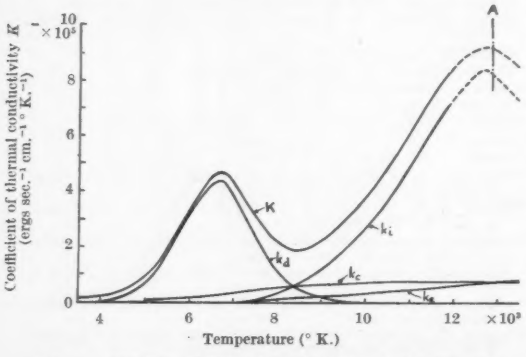

Fig. 1. Variation of thermal conductivity of nitrogen with temperature: k_c, classical conductivity of atoms and molecules; k_e, contribution of free electrons; k_i, contribution from diffusion of ionized pairs; k_d, contribution from diffusion of dissociated pairs; $K = k_c + k_e + k_d + k_i$

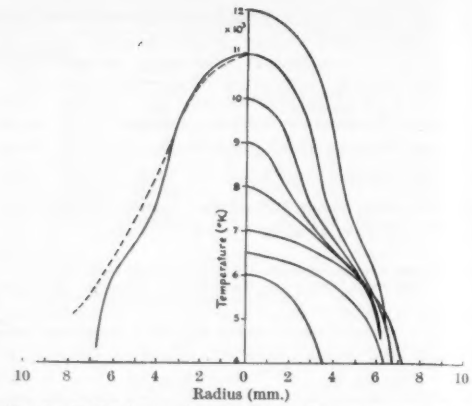

Fig. 2. Radial temperature distribution in arcs: ———, calculated (nitrogen); — — —, experimental Maecker (air, ref. 8)

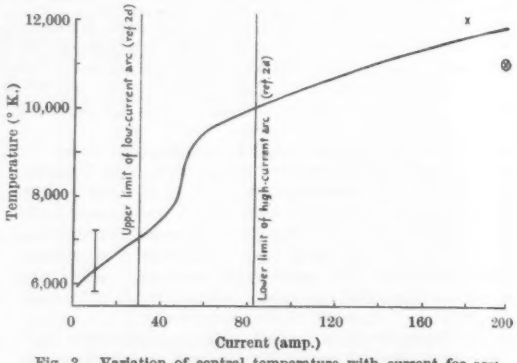

Fig. 3. Variation of central temperature with current for arcs in nitrogen. ×, Ornstein (ref. 9); ⊗, Maecker (ref. 8). Range of observed values for low-current arcs in air is indicated by vertical line on the left

Finkelnburg has suggested[2d] that the upper limit of the 'low-current' arc and the lower limit of the 'high-current' arc are about 7,000° and 10,000° K., respectively, and these values will be seen from Fig. 3 to be in general agreement with the present theory, the transition coinciding with the rapid increase in central temperature between 7,000° and 9,500° K. As regards the current at which the transition occurs, spectroscopic examination of carbon arcs in air in these laboratories showed that at about 50 amp. a narrow central core is formed emitting atomic lines and a continuous background. Though higher values are usually quoted for this transition current for the carbon arc in air, these refer to arcs between cored carbons. The positive column of these arcs contains impurities of low ionization potential which lower the arc temperature, so that the critical transition temperature is only reached at a higher current.

After the transition, the central temperature of the 'high-current' arc increases with current up to the second maximum in the thermal conductivity–temperature curve, which is caused by the increase of thermal conductivity with increase in the fraction of the gas which is ionized; when a temperature of about 14,000° K. is reached a second, inner, core is developed during the succeeding negative slope of

the curve, from point *A*, Fig. 1, onwards. It is suggested that this second 'ionization' core will account for the observations by Guillery and Zill and by Beck of the "supercontracted arc stream" referred to by Finkelnburg[2a].

I wish to acknowledge my indebtedness to Dr. C. E. R. Bruce for instigating this study and to F. Goatcher for general assistance throughout, and to the director of the British Electrical and Allied Industries Research Association, Dr. S. Whitehead, for permission to publish this communication.

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Resistance to Flow of Liquids over Solids by Thin Films extending from the Edge of Pools or from Menisci

IN an investigation on the rate of spreading of liquids, including lubricants, (*a*) as a pool over horizontal surfaces, (*b*) between approaching and receding parallel flats, and (*c*) through capillaries, an unexpected resistance, associated with thin films extending beyond the boundary of the pools or from the menisci, has been measured in each kind of experiment. The angles of contact of water, benzene, *n*-hexane, etc., were small or zero, especially on surfaces wet with the respective liquids, and the large differences between the observed and calculated rates of movement in capillary ascent and fall could not be explained by the usual contact-angle hypothesis using the horizontal component $\gamma \cos \theta$ instead of γ, where γ is the surface tension and θ the angle of contact. Graphs relating the rate of radial spread over a horizontal surface of a pool of liquid with the height or square of the height of the pool were found to be curvilinear with an intercept on the force axis[1]. Similarly, a graph relating the rate of movement of an index of liquid in a precision capillary tube and the force acting was found to be curvilinear even with a liquid such as *n*-heptane[2]. In Fig. 1 is shown such a graph for benzene in a scrupulously

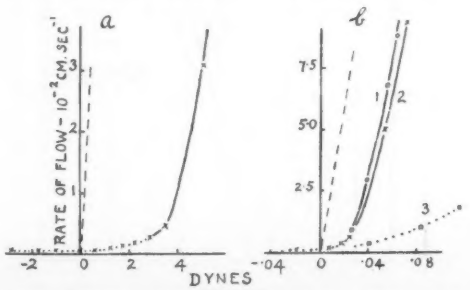

Fig. 1. Relation between rate of flow in a capillary, 1 mm. diameter, and force acting: (*a*) benzene; (*b*) 1, *n*-hexane; 2, *iso*-octane; 3 toluene. Rate of flow in units of 10^{-4} cm. sec.$^{-1}$

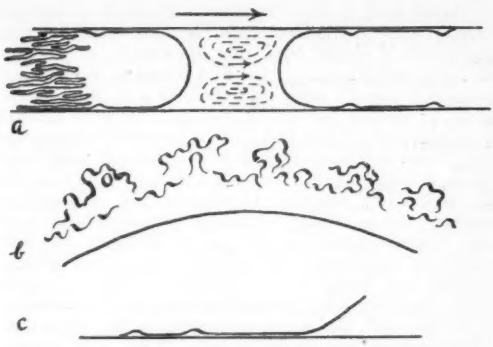

Fig. 2. Thin films adjacent to liquid menisci and pools. (*a*) Benzene index moving slowly in a wetted capillary showing filiform edging of rear thin film (rotation of liquid in index is shown by broken lines). (*b*) Edge of a drop of liquid (after Hirtz and Bernard, ref. 5), and (*c*) side view indicating the thin film ending in a small ridge of liquid

clean dry tube. The dotted-line portion of the graph was for slow movement which was non-Newtonian, the index of benzene ascending a tilted tube (indicated on the graph by a negative force) or passing along a horizontal tube spontaneously. When the tube was tilted down slightly from the horizontal, the rate of movement for small forces remained non-Newtonian and was reversible, the index recoiling when the tube was placed horizontally after movement. More regular movement occurred with forces greater than three dynes, but the rate was considerably less than that calculated from Poiseuille's equation of flow. The predicted rate corrected for flow reversal at the menisci is shown by the broken line.

A similar behaviour can be found with an air bubble moving in a tube filled with liquid. The contact angles appear to be zero, but the top meniscus is flattened and the bottom extended, while the graph relating force acting and rate of movement indicates non-Newtonian movement.

In a dry tube ahead of the advancing meniscus of a column, say, of *n*-heptane, it is possible to see interference colours due to the deposition of a film of heptane, while with water the formation of droplets ahead of the meniscus can be seen under the microscope. Migration of liquid molecules from the liquid front (primary creep) together with vapour deposition is responsible for the presence of thin films ahead of the meniscus and forming part of it, so that its periphery may extend to a distance of several diameters.

In recession, the meniscus is attached to the film on the wet walls, the periphery again being extended to several diameters. The resistance, which is usually much higher for the receding than for the advancing meniscus, varies with the length, elastic properties and strength of the thin films attached, the recessional flow being non-Newtonian and rhythmic in character[3]. In Fig. 2 is indicated the position of the thin films, which usually end in a ridge or in a filiform fringe.

A striking example of the high resistance offered in recessional flow is afforded by the results obtained in the spreading and retraction of a small pool, say of 0·05 ml. of liquid, between approaching and separating parallel flats respectively. In the approaching flats experiment, radial movement during the first stages is approximately in accord with the formula $r^8 = cFt$, where $c = 4V^2/3\pi^3\eta$ and r is the radius of the pool, F the force acting, t time, V the volume

of liquid and η the viscosity. There is a curious hesitation in movement when the film reaches a film thickness of about 10 μ, due apparently to the instability and rupture of the film because of its much increased specific area, and there is a decided resistance to further spreading, which is usually filiform in character[4]. When the force is reversed to separate the plates a hysteresis effect is observed, especially when wetting is poor, as with a pool of 0·05 ml. of a glycerol–water mixture (viscosity, 150 centistokes) between glass surfaces slightly contaminated with oil. When the pool was 3·8 cm. in diameter, the time taken for the plates to separate with a force of 200 gm. weight was found to be 350 sec., which is several times the calculated value. Similarly, with a diameter of 4 cm. and the same force acting, no movement of separation was observed over 24 hr.; on scrupulously clean glass the observed time for separation was several times that of the calculated value, taking into consideration the surface tension forces tending to hold the plates together, namely, $2\pi^2r^4\gamma\cos\theta/V + 2\pi r\gamma\cos\theta$.

It appears that the cavitation of the film, observed during the separation of the plates, together with the filiform periphery, sets up additional surface tension forces to those given above.

Liquids flowing slowly over solids have highly versatile behaviours depending among other things on their molecular structure and aggregation; with toluene, less resistance to flow than with benzene was recorded, while with the xylenes the *para* isomer was found to be the most freely flowing. With binary mixtures of liquids it was possible to correlate increased spreading-rates with lower coefficients of friction and higher strengths of adhesion[1]. With pools of some aliphatic alcohols on brass, methyl alcohol spread the least, but on aluminium it spread the most; of some aliphatic acetic esters on metals and okerin surfaces, methyl acetate was less freely flowing than amyl acetate of higher viscosity.

Acknowledgment is made to the Chief Scientist, Ministry of Supply, for permission to publish this communication.

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A New Type of Diffusion Cathode

Recent progress in the field of thermionic emitters has largely been directed towards obtaining continuous current densities higher than those which can be obtained from oxide cathodes with reasonable lives. Examples of this trend are the *L* cathode[1], the impregnated tungsten cathode[2] and the moulded nickel–barium carbonate layer cathode[3].

A new type of cathode combining the features of the impregnated *W* cathode and the moulded cathode has recently been developed. The cathode is made by preparing a mixture of nickel powder and barium–strontium carbonate powder. A small percentage of an appropriate reducing agent is added to the mixture. The ball-milled mixture is loaded into a retaining cylinder, which may be of nickel, 'Kovar' or molybdenum or other suitable refractory material and is compressed using a pressure which is determined by the desired value of final porosity. Typical cathodes contain 70 per cent by weight of nickel powder, 29 per cent barium–strontium carbonate and 1 per cent zirconium hydride. Pressures of between 20 and 160 tons/in.^{2} have been used. The retaining cylinder is then removed from the press tool and is mounted in the valve in the ordinary way, the pressed emitting material being mechanically strong and well able to resist the stresses experienced in handling and mounting.

The outgassing and activation procedures are similar to those usually employed with oxide cathodes except that the times are somewhat longer. The emission is allowed to build up to between 1–3 amp./cm.^{2} on the pump before sealing off, and when carefully stabilized cathodes for measurement purposes are required, the cathode is aged at the same density for several hours after seal-off.

Fig. 1 shows typical pulsed-emission results for these cathodes, compared with conventional oxide cathodes and with published data for the *L* cathode. These results are very similar to those of MacNair, Hannay and Lynch. The graph also shows data representing conditions under which good modern oxide cathodes can be operated for reasonable lives and a tentative line for the new *BN* cathode. Diodes using *BN* cathodes have survived 3,000 hr. at 3 amp./cm.^{2} and 1,070° C., and 6,000 hr. at 1·5 amp./cm.^{2} and 1,020° C. They are resistant to ionic

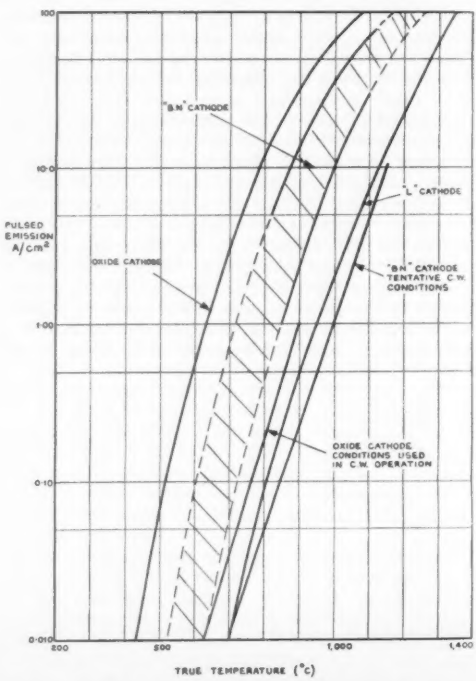

Fig. 1. Curves of emission as a function of temperature for oxide, *L* and *BN* cathodes

bombardment and have been very satisfactorily used in demountable vacuum apparatus.

Measurements of work function by the usual saturation emission method lead to a value for φ_0 about 1·8 eV. Retarding field values of φ lead to a value of about 2·8 eV. We interpret these results as meaning that the emission originates from an incomplete monolayer of barium ions, with about 70 per cent surface coverage. The temperature coefficient of the work function is about $1{\cdot}4 \times 10^{-4}$ eV. per deg. K.

A paper describing this work in more detail was read at the recent Congrès International du Cinquentenaire de la Cathode à Oxydes and will be published in the Proceedings of that Congress to appear in *Le Vide*.

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Thermal Expansion of Grey Tin

No work appears to have been reported on the thermal expansion of grey tin and it may be of interest, therefore, to give some X-ray measurements that we have made on this material at temperatures between room temperature and − 130° C. These are shown in Fig. 1, from which it will be seen that the coefficient of expansion is sensibly constant within the range quoted. The value actually works out to be $4{\cdot}7 \times 10^{-6}$ per degree C. The measurements were made with a 'Unicam' 19-cm. powder camera modified as described in a note to be published by us elsewhere. Unfiltered copper *K*-radiation was used.

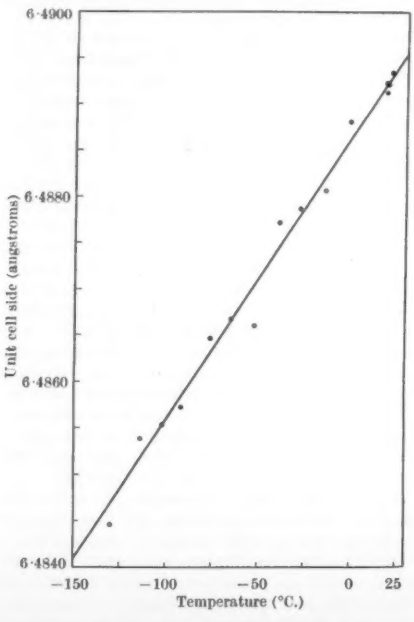

Fig. 1. Thermal expansion of grey tin

The value of the unit-cell side, 6·4892 ± 0·0001 A. at 20° C. (assuming 1·54050 A. for the wave-length of copper $K\alpha_1$), is significantly less than that reported by Brownlee[1], namely, 6·4912 ± 0·0005 A. However, the nature of our curve and the measurements actually made at room temperature (on two different specimens) suggest that our results are substantially correct, especially as the values of the lattice parameters of other materials obtained with the same camera under similar conditions are found to agree with the accepted values for these parameters within the experimental error claimed. We are informed by the Tin Research Institute, to which body we should like to express our thanks for supplying the tin, that the purity of the material we examined was 99·99 per cent, the main impurities being lead and antimony. These impurities would account at most for an error of about the same magnitude as our experimental error, and therefore the discrepancy is left unexplained.

Mr. J. T. Kendall, who supplied the tin used by Brownlee, has informed us that his sample was also very pure, being prepared from Johnson–Matthey's 'spectroscopically pure' material.

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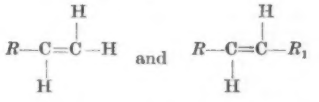
Infra-Red Assignments of Unsaturation in the Region 900–1,000 cm.$^{-1}$

The region 900–1,000 cm.$^{-1}$ of the infra-red spectrum of organic molecules is useful for characterizing the type of unsaturation that may be present. This region is associated with the bending frequencies of hydrogen attached to an olefinic carbon. Thus the groups



give rise to characteristic bands at 909–916 cm.$^{-1}$ and 964–979 cm.$^{-1}$ respectively[1].

Recent work by Jackson *et al.*[2] and Privett *et al.*[3] on the linoleates has enabled further assignments to be made in this region. *Trans-trans* conjugation is characterized by an absorption band at 988 cm.$^{-1}$, whereas *cis-trans* conjugation is characterized by absorption bands at 948 and 982 cm.$^{-1}$. However, when the spectrum of all *trans* vitamin A (which has five conjugated double bonds) is examined, there is one very strong band in the region 900–1,000 cm.$^{-1}$, but this lies at 968 cm.$^{-1}$, a position which is normally held to characterize only an isolated *trans* unsaturated bond. This is illustrated in Fig. 1, which shows the infra-red absorption spectrum of vitamin A palmitate, the 968 cm.$^{-1}$ band being characteristic of both the free alcohol and of its esters. The spectrum of β-carotene, which is a precursor of vitamin A and contains eight conjugated double bonds, is also similar in this respect.

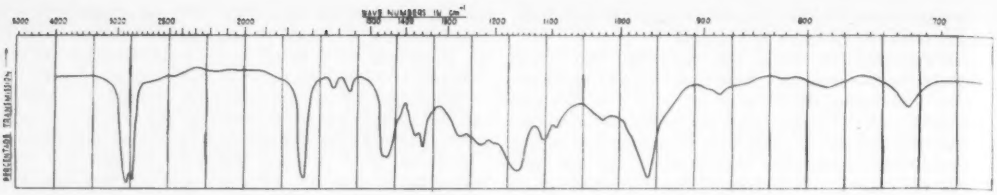
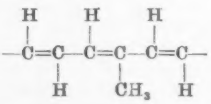


Fig. 1. Infra-red absorption spectrum of vitamin A palmitate

The molecular structures of these compounds show a branched methyl group on alternate double bonds thus :



and since the hydrogen bending vibration in the $CHR_1 = CHR_2$ (*trans*) group appears to behave as though isolated and unaffected by this type of conjugation, it is to be expected that a band arising from the hydrogen bending vibration in the group $CR_1R_2 = CHR_3$ would occur in the region 803–833 cm.$^{-1}$. In fact, however, only a very weak band near 825 cm.$^{-1}$ occurs in the vitamin A spectrum.

In the C = C stretching region, if the $CHR_1 = CHR_2$ (*trans*) and $CR_1R_2 = CHR_3$ groups behaved as isolated non-conjugated groups, two bands would be expected[4] to occur near 1,670 cm.$^{-1}$; in fact, however, two bands at 1,623 cm.$^{-1}$ and 1,565 cm.$^{-1}$ are observed (Fig. 1), showing that the conjugation does affect the C = C stretching vibration.

From the practical point of infra-red analysis of unknown materials, although the 968 cm.$^{-1}$ band is generally assigned to isolated (non-conjugated) *trans* unsaturated bonds, it follows from the above that this is not always correct.

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Iodometric Assay of Penicillinase

The series of iodometric methods[1] for assaying penicillinase reported here permits enzyme activity to be measured easily over wide ranges of *p*H and temperature, with higher speed, accuracy or sensitivity than were previously attainable[2]. Although designed for the penicillinase of *B. cereus* NRRL-569, it appears likely that they may be equally suitable in principle for penicillinase from other sources. 'Unit rate of penicillin destruction' is used here to mean a destruction-rate of 1 μmol./hr. Since the amount of a penicillinase which will give unit rate of destruction depends on the nature of the enzyme and the conditions to which it is exposed, a 'unit dose' (U.D.) of *B. cereus* NRRL-569 penicillinase is here defined as that amount of the enzyme which gives unit rate of destruction when exposed to 0·005 *M* sodium benzyl penicillin in 0·2 *M* potassium phosphate buffer at *p*H 6·5 and 30° C. The commercial crystalline sodium penicillin *G* of Glaxo, Ltd., is used in the following assays ; its potency is stated to be 1,650 I.U./mgm.

Before performing an accurate assay it is necessary to know the approximate activity of the enzyme sample, which is determined in the following manner. To 50 ml. of 0·0014 *M* penicillin in 0·02 *M* phosphate buffer, *p*H 6·5, is added 2 ml. of 2 per cent sodium starch glycollate[3] and 0·01 *N* iodine, dropwise, until a faint blue colour persists for 3 min. : a further 6 ml. of iodine is then added. This deep-blue reagent, freshly prepared, is mixed in a test-tube in the proportion of 2·5 ml. to 0·5 ml. of enzyme, and the time-interval until decolorization is noted. At a room temperature of about 22° C. the product, *P*, of activity and time is constant within ± 10 per cent, for purified enzyme samples, over a time-range of about 0·5–15 min., which corresponds to an activity range of between 60 and 2 U.D. of enzyme. If crude preparations of enzyme with a high non-specific iodine uptake do not give a constant value for *P*, standards of known activity are included in each run. Two operators can assay about fifty samples an hour by this method.

The accurate version of the assay is carried out as follows. A stoppered 60-ml. reagent bottle containing 5 ml. of an ice-cold 0·007 *M* solution of penicillin in 0·2 *M* phosphate buffer, *p*H 6·5, is mounted so that it can be gently shaken in a water-bath at 30° C. The enzyme for assay, pre-warmed to 30° C., is added after 10 min. : it should consist of not more than 20 U.D. of activity in not more than 2 ml. of solution containing 0·5 per cent gelatin[4]. After a further 30 min., shaking is stopped, and the enzyme reaction arrested by adding 10 ml. of an iodine reagent also prewarmed to 30° C. ; this reagent is 0·0166 *N* iodine, 0·06 *M* potassium iodide and 1·75 *M* sodium acetate buffer, *p*H 4·00. Ten minutes later, the bottle is removed from the bath and titrated with 0·0166 *N* thiosulphate : if the titration is less than 4·5 ml., the assay is repeated with diluted enzyme. Under these conditions, 1 ml. 0·0166 *N* iodine is equivalent to 2 μmol. of penicillin destroyed. Corrections for spontaneous decay of penicillin and the iodine uptake of crude enzyme samples are determined from suitable controls. By starting assays at 3-min. intervals, two operators can perform ten in an hour. Accuracy of the method is within the limits of good volumetric technique : sensitivity is 0·04 U.D. of enzyme, but may be increased tenfold by lengthening the reaction-time to 5 hr.

This accurate assay may be modified to work over a wide range of conditions providing certain properties of the system are taken into account : (*a*) the K_m of *B. cereus* NRRL-569 penicillinase is about 7×10^{-5} *M* ; the influence of *p*H and temperature on its effective rate of destruction of penicillin under certain conditions is shown in Figs. 1 and 2 (these properties

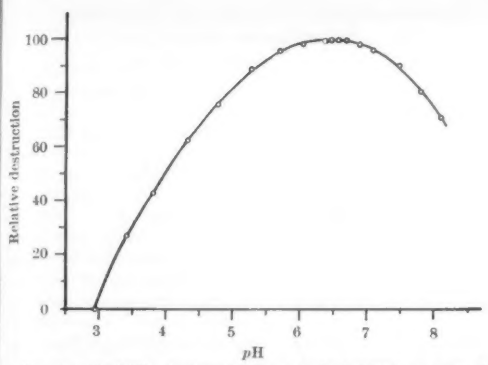

Fig. 1. Penicillin destroyed by a constant initial amount of enzyme at various *p*H's, expressed as percentage of penicillin destroyed at *p*H 6·5. Time 30 min.; temperature 30° C.; phosphate–citrate buffer. Each point is the mean of two determinations

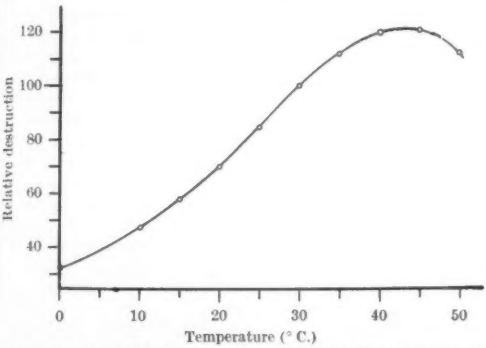

Fig. 2. Penicillin destroyed by a constant initial amount of enzyme at various temperatures, expressed as percentage of penicillin destroyed at 30° C. Time 30 min.; *p*H 6·5; phosphate buffer. Each point is the mean of three determinations

were determined by iodometric methods and differ slightly from those previously reported[2]; (*b*) a residual iodine concentration of at least 0·0045 *N* at the beginning of the titration seems desirable; (*c*) under the conditions described, the degradation products of 1 molecule of penicillin reduce 8·3 atoms of iodine: under other conditions, that particular relationship will probably not apply[1], and the iodine equivalence must be re-determined using the product of complete enzymic degradation of a known amount of penicillin.

A very sensitive means of detecting penicillinase exploits the widely different partition coefficients of iodine and iodide between carbon tetrachloride and water. If penicillin partially degraded by penicillinase is shaken with a solution of iodine labelled with iodine-131 in carbon tetrachloride, the aqueous phase acquires an amount of radioactivity, in the form of iodide, which is a function of the amount of penicillin destroyed. With highly purified enzyme, 2×10^{-5} *M* penicillin and 5×10^{-5} *N* iodine containing 10 μc. iodine-131/ml., it has proved possible to detect 3×10^{-6} U.D. of penicillinase (about 4×10^{-19} mol. of enzyme if its molecular activity[5] is $1{\cdot}3 \times 10^{5}$). Unfortunately, the conditions for attaining such sensitivity are so rigorous that further refinement of the method seems useless.

The iodine – penicilloic acid reaction can also be used for identifying colonies of penicillinase-producing bacteria in solid media. The indicator is incorporated in the medium; after incubation, the plate is flooded with 0·1 *M* penicillin and left for 15 min. or more at 2° C. The penicillin is then replaced by iodine of suitable strength (depending on the nature of the medium and the activity of enzyme present). Colonies of penicillinase-producers are surrounded by colourless zones which increase in area with time.

These methods and their experimental justification will be reported elsewhere in detail. I am grateful to Miss Daphne Towler and Miss Audrey Hearle for expert technical assistance.

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Utilization of Formate-^{14}C for Synthesis of Deoxyribonucleic Acid by Human Bone Marrow Cells *in vitro*

Previous publications[1,2] have reported on the incorporation of adenine-^{14}C into ribonucleic acid and deoxyribonucleic acid by human bone marrow cells *in vitro*. Using a high-resolution autoradiography technique[3], the grain counts over the individual cells before and after hydrolysis with *N* hydrochloric acid at 60° C. for 6½ min. indicated a slightly larger amount of adenine-^{14}C incorporated into ribonucleic than into deoxyribonucleic acid, in 24-hr. cultures (see Fig. 1).

Similar experiments were performed using 0·75 μc./ml. sodium formate-^{14}C in the culture medium. Isomolar (0·75 millimolar) concentrations of formate-^{14}C and adenine-^{14}C were used, these concentrations being in excess of those permitting maximum

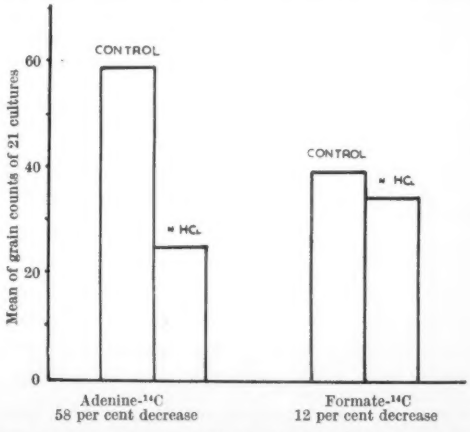

Fig. 1. Effect of *N* hydrochloric acid at 60° C. for 6½ min. on the carbon-14 content of cells

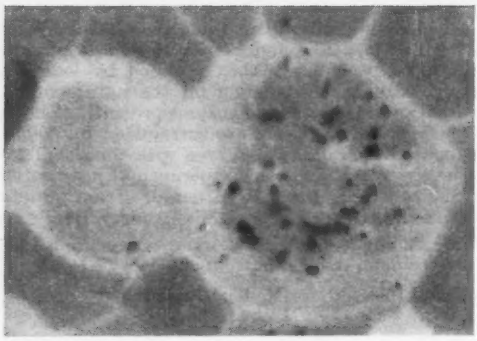

Fig. 2. Formate-^{14}C uptake by human bone marrow cells *in vitro* in 24-hr. culture with 0·75 μc./ml. formate-^{14}C medium. Smear alcohol fixed, not acid hydrolysed. Stained autoradiograph, × 2,000. Note the localization of the isotope in the chromosomes

uptake by the cells. The difference in the specific activities (1·04 mc./m*M* for formate-^{14}C, and 1·56 mc./m*M* for adenine-^{14}C) was compensated for in the exposure times of the autoradiographs, namely, ten days for adenine-^{14}C slides and seventeen days for formate-^{14}C slides. The grain counts on the acid-hydrolysed slides indicated a similar amount of carbon-14 uptake in both cases, the average maximum uptake being of the order of $1{\cdot}2 \times 10^7$ atoms of deoxyribonucleic acid-^{14}C.

However, the comparison of the non-hydrolysed and acid-hydrolysed preparations from the formate-^{14}C cultures indicated scarcely any change in the average maximum grain counts after hydrolysis (see Fig. 1). The failure of acid hydrolysis to remove appreciable amounts of carbon-14 from the cells, together with the predominantly nuclear (and chromosomal) localization of the isotope on the non-hydrolysed preparations (Fig. 2), indicated that, as opposed to adenine-^{14}C, most of the formate-^{14}C taken up by human bone marrow cells *in vitro* is incorporated into deoxyribonucleic acid, and only a very small fraction is incorporated into other compounds (for example, ribonucleic acid).

These findings are at variance with those obtained in rat liver with formate-^{14}C [4,5]; but the cause of the difference may lie in the different rates of synthesis of deoxyribonucleic acid in bone marrow and resting liver. There is evidence that in chick bone marrow slices more than 70 per cent of the formate-^{14}C in deoxyribonucleic acid is found in the methyl group of thymine[6], and preliminary experiments in our laboratory also indicate that probably most of the formate-^{14}C administered to human bone marrow cells *in vitro* is incorporated into thymine in deoxyribonucleic acid.

This work is part of an investigation carried out under a full grant from the British Empire Cancer Campaign.

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Cocarboxylasic Activity of Thiamine Phosphoric Esters

After the chemical synthesis of thiamine phosphoric esters was achieved[1–4], reports were published on their cocarboxylasic activity[3–7]. Investigations have shown that monophosphothiamine has no cocarboxylasic activity, but different values have been found for the activity of triphosphothiamine. The discrepancies may be accounted for by the facts that: (*a*) chemical synthesis provides mixtures of three esters (mono-, di- and tri-phosphoric) which are very difficult to separate; (*b*) diphosphothiamine is very active; and therefore quantities as small as 0·1 γ/ml. occurring as impurities with the other esters invalidate the results; (*c*) washed yeast, which has usually been employed as apoenzyme, makes it difficult to reproduce results.

We have separated the esters by paper chromatography[7], employing Whatman No. 1 paper and *n*-propanol – water – 1 *M* acetate buffer, *p*H 5 (70 : 20 : 10), as the solvent.

The position of each ester was established by developing duplicate spots in parallel and spraying one of the series. Fragments of strips not sprayed were placed in Warburg flasks and compared with known amounts of chromatographically pure diphosphothiamine under identical experimental conditions.

As apoenzyme we have used purified apocarboxylase according to Green *et al.*[8]. Each flask contained: an amount of apoenzyme which in the presence of excess (80 γ) of diphosphothiamine produces carbon dioxide at $4{\cdot}0 \times 10^3$ μl./hr.; 0·27 mgm. of magnesium ions and 0·19 mgm. of manganese ions; in the side bulb, 0·4 ml. of 1·09 *M* sodium pyruvate; 0·04 *M* citrate buffer, *p*H 6·0, making up the volume to 3·0 ml.; temperature, 30° C.; atmosphere, air; shaking, 160–170 oscillations/min. The rate of evolution of carbon dioxide was determined by a graphical method[9]. The manometers were read every 2 min. after allowing 15 min. for the establishment of equilibrium. The quantities of each ester were established by colorimetric determination of phosphorus[10].

The following results were obtained: (1) monophosphothiamine at concentrations of 0·025–0·13 μmol./ml. did not manifest any cocarboxylasic activity; (2) diphosphothiamine at a concentration of 0·04 μmol./ml. liberated carbon dioxide at the rate of $2{\cdot}3 \times 10^3$ μl./hr.; (3) triphosphothiamine at concentrations of 0·005–0·020 μmol./ml. did not manifest any cocarboxylasic activity.

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A Further Serological Distinction between the Hæmagglutinins of *Dolichos biflorus* and *Phaseolus lunatus*

Seed hæmagglutinins have recently been investigated in considerable detail. Many botanical species contain non-specific agglutinins for human erythrocytes and some contain agglutinins which are relatively or absolutely specific[1-3].

Krupe[4] has demonstrated the presence of incomplete antibodies in various seeds. The action of seed agglutinins on enzyme-treated cells is now being investigated in our laboratories. The enzyme used is papain and the technique that described by Stratton[5]. Detailed results will be published in due course.

Bird[6] has directed attention to the fact that there is a difference in the serological reactions of extracts of two *A*-specific seeds, *Dolichos biflorus* and *Phaseolus lunatus*. The former act strongly on A_1 and A_1B cells and relatively weakly on A_2 and A_2B, whereas the latter act more uniformly on these sub-groups.

The present communication reports a more marked serological distinction between the two agglutinins. *Phaseolus lunatus* extracts act upon papainized erythrocytes of groups *B* and *O*, whereas *Dolichos biflorus* extracts retain their specificity for *A* cells when tested under identical conditions (see table).

Titres of Untreated and Papainized Cells against *A*-Specific Seed Extracts

	Untreated cells Group			Papainized cells Group		
	A	*B*	*O*	*A*	*B*	*O*
Dolichos biflorus	1,024	0	0	32,768	0	0
Phaseolus lunatus	2,048	0	0	65,536	8	8

These observations are in keeping with the fact that extracts of some varieties of *Phaseolus lunatus* act weakly on *B* and *O* cells[2], and the observation that these extracts act strongly on panagglutinating (infected) cell suspensions irrespective of their *ABO* group (unpublished results). On the other hand, *Dolichos biflorus* extracts are not known to act on *B* and *O* cells, and do not lose their specificity when tested with panagglutinating cell suspensions (unpublished results).

It appears that *Dolichos biflorus* agglutinins have a greater degree of specificity for the agglutinogen *A* than was originally appreciated.

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Mechanism of Hypotensive Action of Reserpine, an Alkaloid of *Rauwolfia serpentina*

Studies on the pharmacology of extracts of *Rauwolfia serpentina* have been reported by Chopra, Gupta and Mukherjee[1], Ray *et al.*[2] and Dasgupta *et al.*[3]. Chopra, Gupta and Mukherjee[1] reported that the alkaloid with which they were working had a marked hypotensive effect which was in part due to depression of central nervous mechanisms, since it was less marked in decerebrate animals, but appeared also to result in part from a direct inhibitory effect on the musculature of the blood vessels. They demonstrated also a fall in the output of the isolated heart. Most subsequent work has suggested that the hypotensive effect of *Rauwolfia* alkaloids is mediated solely via central nervous mechanisms.

A new alkaloid, now named reserpine, was isolated by Müller, Schlittler and Bein[4], and pharmacological studies on the action of this alkaloid have been published by Bein *et al.*[5], Bein[6], and Trapold *et al.*[7]. Their results were in conformity with those of other workers on *Rauwolfia*, who reported it to act via the central nervous system, and they emphasized particularly its capacity to inhibit reflex pressor responses.

Our own studies have confirmed that reserpine diminished reflex vasomotor responses, but have also demonstrated a direct effect on the peripheral vessels independent of its nervous activity. This action is most clearly seen in the rabbit; we employed the preparation devised by Gallagher[8], in which the innervated but otherwise isolated hind-limb is perfused with a blood–dextran medium at constant rate. Changes in vasomotor tone in the limb are indicated by alterations in perfusion pressure. We have found that injections of reserpine into the systemic circulation of the rabbit produce an immediate fall in systemic blood pressure. This is accompanied by an immediate rise in limb perfusion pressure instead of a fall, as would have been expected were the fall of blood pressure mediated through the nervous system. Furthermore, injection of reserpine directly into the artery of the perfused hind-limb causes immediate diminution in vasomotor tone. Reserpine has also been shown to have a depressant effect on the action of vasopressor substances injected into the isolated rat hindquarter preparation and on the response to nervous stimuli of isolated portions of rat diaphragm. A feature of all these reactions is their remarkably prolonged duration, suggesting binding of the drug by the musculature.

We have also obtained evidence that such a direct peripheral effect may play some part in the hypotensive action of reserpine in man. We have found that the blood pressure in the supine position can be brought to a lower level by the combined action of reserpine and large doses of hexamethonium bromide than by hexamethonium alone.

Papers embodying the results of these studies are being prepared and will be published elsewhere.

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A Centrifuging Method for Root Sterilization

In isolating mycorrhizal fungi present in root tissues, the external surfaces must be sterilized without damaging the hyphæ within. Existing techniques involving chemical sterilization or removal of the epidermis under aseptic conditions were found to be unsatisfactory in *Calluna vulgaris* and *Vaccinium myrtillus*, as they involved loss of hyphæ in the epidermis where the hyphæ were concentrated. Accordingly, a centrifuging technique was devised which obviated these difficulties.

The apparatus consists of a small glass tube, fitted into a 'Pyrex' centrifuge tube. A piece of fine muslin is stretched across the top of the inner tube and secured by waterproof adhesive tape. The base of the inner tube is wrapped in cotton wool. This is essential for even distribution of pressure during centrifuging. Sufficient sterile water is added to cover the muslin.

The roots to be surface-sterilized are thoroughly washed in detergent before being placed on the muslin of the inner tube. They are then centrifuged for three to four minutes at 7,500 rev./min., removed and shaken vigorously in two tubes of sterile water to dislodge contaminants still attached to the root surface. Prior to each centrifuging, 50 per cent alcohol is used to sterilize the apparatus. Three times in the centrifuge, each time followed by agitation in two tubes of sterile water, except after the last, when four tubes are used, results in a high proportion of surface-sterile root sections 3–5 mm. in length.

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Environmental Determination of the Sex Ratio of a Plant Parasitic Nematode

The sex ratio of the potato root eelworm *Heterodera rostochiensis* Wollenweber has been under investigation in this laboratory since 1950. From the first it appeared that the ratio is very variable; it is now clear (*a*) that the ratio can be different on primary and lateral roots, and (*b*) that it varies with the intensity of infection.

Plants were raised in pots and grown either on a laboratory window bench or in the field: either they were grown in soil containing eelworm cysts or in sterile sand to which larvæ were added afterwards. As earlier stages are difficult to identify with reasonable ease and certainty, all plants were lifted when the males were adult but still 'encysted'; at this stage females are swollen but still within the root tissues. But as the males leave the roots soon after, care was taken to lift the plants in time. The roots were then carefully washed, treated with lactophenol-acid fuchsin in the standard way[1], and the number of adult males and females counted with the aid of a dissecting microscope; no attempt was made to sex early stages, but the total number of worms was noted. Although most of the worms are readily visible, it was nevertheless necessary more or less to dissect the root system to ensure that all worms were found; and, in the case of the field-grown plants where the root system was particularly extensive, sometimes only a sample of the root system was examined. I am most grateful to Mrs. E. Capstick for the care with which she carried out these examinations.

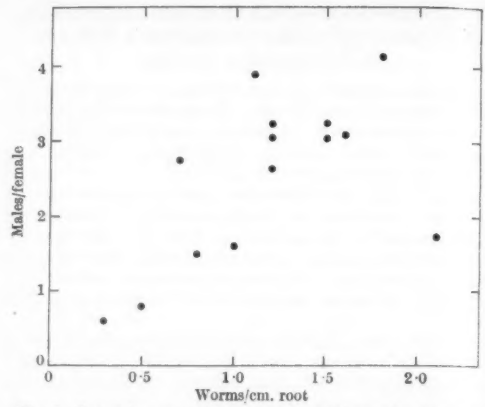

Fig. 1. Increasing proportion of males with increasing intensity of attack

The results for fourteen plants, part of a typical experiment with a number of potato varieties, are shown in Fig. 1; the different plants are compared on the basis of the length of primary roots of the root system examined. The sex ratio (males per female) is plotted against intensity of attack; it will be seen that, as the intensity increases, a higher proportion of males is found, the sex ratio changing from about 1 : 2, at the lower levels, to about four males to one female at the upper end; and higher values have frequently been found. 'Intensity of attack' was estimated from the number of worms of all stages per cm. of primary root, although, of course, worms in both primary and lateral roots are included. The method is not beyond criticism; indeed, an investigation of alternatives, such as the exclusion of juveniles, may itself help to clarify the situation. But other standards do not alter the general trend: the higher the intensity of attack, the higher the proportion of males, or the lower the reproductive rate.

Clearly, the phenomenon may help to explain the puzzling manner in which soil populations of the potato[2,3] and the closely related beet eelworm (*H. schachtii*)[4] increase; for the rate of multiplication decreases with the number of eelworm eggs in the soil.

A fully developed female with her many hundreds of eggs must be a considerable drain on the host plant. Whatever the mechanism, therefore, a reduction in the relative number of females with intensity of attack is a remarkable adaptation. There appear to be two possibilities: either the change in sex ratio is achieved as a result of a differential death-rate; or it is due to environmental influence on the process of sex determination.

A differential death-rate could operate by eliminating a progressively higher proportion of females before they reach the host plant; alternatively, progressively more females might fail to reach maturity within the plant. Careful examination of a number

Table 1. Distribution of Sexes on Primary and Lateral Roots. Figures are mean values per plant for young plants grown in pots to each of which 900 larvæ were added

	Adult male	Adult female	Male/female	Unclassified
Primary	38·3	23·8	1·61	24·9
Lateral	172·9	20·7	8·35	45·1

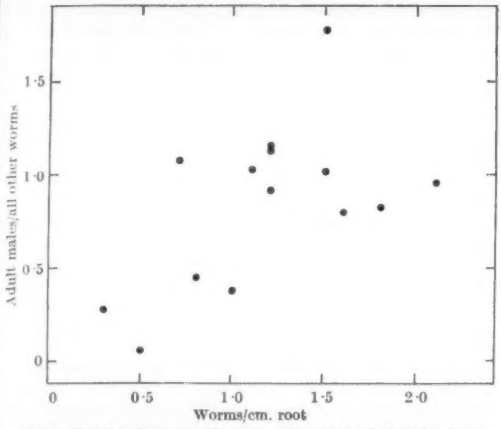

Fig. 2. For this diagram, all worms, other than adult males, have been assumed to be potential females. The increase in the proportion of males, with increasing intensity of attack, is therefore not due to a higher death-rate of females within the host plant

of plants grown in sterile sand to which larvæ were afterwards added showed in every case that the proportion of males to females was very much higher on the lateral roots than the primary roots from which they arose. The mean values are shown in Table 1; there are roughly five times more males per female on the lateral roots than on the primaries. The figures for the unclassified worms show that the difference cannot be due to any difference in rate of development, for the proportion of unclassified worms is rather higher on the primaries. This difference between primary and lateral roots would appear to eliminate the possibility of differential soil death-rate—unless it were also associated with a male preference for lateral roots.

We are confident that the worms counted as neither adult nor female were in fact juveniles and not corpses. Nevertheless, although they show no obvious signs of degeneration, it must be admitted that it may not be easy to distinguish between an eelworm which has died of natural causes and one which has been freshly killed by the fixative. Accordingly, all worms were counted as female which were not adult male; that is, all previously unclassified worms were added to the female total. The recalculated and heavily weighted 'sex-ratios' have been plotted against intensity of attack in Fig. 2; even in such unfavourable circumstances, they still show a very strong trend, the proportion of males increasing with increasing intensity of attack. This is decisive evidence against a differential death-rate in the host as the cause of the trend. Clearly, the process of sex determination is under environmental influence.

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Eradication of *Venturia inaequalis* (Cooke) Wint.

The control of apple scab or black spot, caused by *Venturia inaequalis*, using protective and eradicant-protective spray programmes during the parasitic phase of fungal activity has reached a stage beyond which further substantial improvement is unlikely. With modern machinery and modern chemicals, good control of the disease can be achieved in normal seasons in New South Wales, but the cost of the control programme is very high and heavy losses still occur under extreme infection conditions.

In 1937, Keitt and Palmiter[1] reported failure to eradicate the disease by attempting to break the cycle of fungal development with autumn foliage sprays of copper – lime – arsenite mixtures and with a late-winter ground spray of ammonium sulphate. Since then many attempts have been made to break the cycle during the saprophytic phase, using eradicant ground sprays. These attempts to kill the maturing perithecia have failed to eradicate the disease, due to the impossibility of hitting all fallen leaves with the chemical and to the incompletely eradicant action of some of the chemicals used.

The use of eradicants in the pre-leaf-fall period to prevent the fungus entering the saprophytic phase has received much less attention, and consequently a re-investigation of this aspect was undertaken using some new eradicant fungicides. Of these, phenyl mercuric chloride appeared most promising. In numerous reports, such as those of Fitzgibbon[2] and of Marsh[3], its outstanding fungicidal ability and low phytotoxicity at low concentration have been stressed. In 1952, Byrde *et al.*[4] reported the successful use of this chemical at high concentration as an autumn spray in preventing sporulation of *Nectria galligena* Bres. on apple trees, thereby demonstrating its extreme eradicant action and non-phytotoxicity.

In late autumn (May) 1953 at Orange, New South Wales, sprays of phenyl mercuric chloride (0·3 per cent), sodium pentachlorophenate (0·5 per cent) and sodium dinitro-*o*-cresylate (0·5 per cent) were applied to Delicious apple trees heavily infected with black spot. The latter chemical caused much leaf burning and leaf rolling, but did not damage bark or buds. The other two materials caused no injury.

Two weeks after spraying, when the foliage was falling freely, samples of leaves from each treatment and unsprayed leaves were collected and allowed to over-winter under orchard conditions at Orange. From the end of September sub-samples from each were examined at weekly intervals for the presence of perithecia and for perithecial maturity as determined by intensity of ascospore discharge in the laboratory.

In the unsprayed leaves perithecia were abundant, ascospore discharge commenced in late September, rose to maximum intensity in early November, fell away quickly at first and then gradually, until it ceased at the end of January.

In the leaves sprayed with phenyl mercuric chloride, no mature perithecium was observed and from these leaves no ascospore of *Venturia inaequalis* was discharged during the testing period (October 2–December 31). Both discrete and diffuse scab lesions were observed on most of the leaves, and the absence of perithecia suggests that the fungus was killed in the sub-cuticular stromatic layer before the initiation of the saprophytic phase.

Sodium dinitro-*o*-cresylate caused a considerable reduction in effective perithecial development, and this was reflected in a low rate of discharge of ascospores.

Perithecia were plentiful in the leaves sprayed with sodium pentachlorophenate and were more advanced in maturity than those in the unsprayed leaves, ascospore discharge reaching peak intensity in mid-October. The rate of ascospore discharge was greater than from the leaves sprayed with sodium dinitro-*o*-cresylate but much less than that from the unsprayed leaves.

Further investigations have been undertaken this autumn (March–May) to determine the minimum concentration of phenyl mercuric chloride for eradication of *Venturia inaequalis* from infected apple leaves, and to test the possibility of eradicating apple scab from heavily infected isolated orchards using phenyl mercuric chloride at high concentration immediately after the completion of harvesting. It is hoped that this eradication measure will also eliminate the fungus from infected bud-scales, a source of inoculum demonstrated by Cass Smith *et al.*[5] to be important in the disease cycle.

Full details of the techniques employed and results obtained in these investigations will be published elsewhere.

I wish to thank the field horticulturists of the N.S.W. Department of Agriculture who are assisting with these investigations, and Mr. E. C. Whittaker, fruit officer at Orange, in particular, whose co-operation in applying the sprays and forwarding sub-samples of leaves made possible the initial investigation.

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Concentration of Potato Root Diffusate by Vacuum Distillation

Potato root diffusate, which is the liquid obtained by leaching growing potatoes with water, has long been known[1] to contain an active factor which causes the larvæ to emerge from eggs contained within cysts of the potato root eelworm, *Heterodera rostochiensis*. Since the War, considerable research has been carried out in an attempt to ascertain the chemical constitution of the active factor[2]. At normal room temperature potato root diffusate is extremely unstable; hence the diffusate is stored in refrigerators, where it remains relatively stable for a considerable time.

Some method of concentrating the diffusate was imperative because it was becoming increasingly difficult to store bulk quantities of diffusate in refrigerators. The convenience of storage was the main reason for concentrating the diffusates, but other factors are also of importance.

Dilutions of the concentrate could be used for a large number of assays at the same time, hence ensuring that each experiment received the same hatching stimulus and thus removing one difficulty normally encountered in eelworm assay. Moreover, the gradual decomposition of a sample of root diffusate can be corrected by concentration and subsequent redilution. There is no reason for supposing that concentrated root diffusates differ from ordinary samples in their rate of decomposition, so that while tests are being carried out on their relative stability, the concentrates are kept at 3–4° C.

It was decided to prepare the concentrate by vacuum distillation at 5° C. and a pressure of 1 mm. mercury; the water which distilled was collected at − 20° C., until the volume remaining in the still was between 1 and 4 per cent of the original. In some samples further concentration was effected by freeze drying. Afterwards, dilutions were prepared for biological assay so that concentrations lay on a logarithmic scale[3].

Results showed that 90–95 per cent of the active principle remained undecomposed after vacuum distillation when comparing the diluted concentrate against the original sample. A rather greater loss, of 30 per cent, occurred with the freeze-dried material.

For all samples investigated an optimum hatch was observed (Table 1), confirming the suggestion by Calam *et al.*[2]. For concentrations higher than that which produce the optimum hatch, fewer larvæ emerged from the cysts. Thus two widely spaced concentrations of the hatching stimulant produce similar hatches, and this introduces complications into the bioassay of this substance, for which no chemical assay is as yet available.

Table 1. Percentage Hatch of Larvæ from Cyst

Exp.	Dilution of root diffusate							
	1/1	1/4	1/16	1/64	1/256	1/1024	1/4096	Original sample
A	20	33	40	38	18	12·5	7·6	44
B	78	79	84	78	65	43	19	87
C	4	33	62	29	17	16	7	41

It is not yet certain whether the reduced hatch at higher concentrations is due to inhibition by soil nutrient salts or to the root diffusate factor itself. Recent experiments in which the potatoes, grown in silver sand, are leached with distilled water, suggest that the inhibition is associated with enhanced concentrations of the hatching factor.

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Augmentation of Wool-growth by l-Thyroxine and Tri-iodo-thyronine in Sheep

The photoperiodic response giving increased wool-growth in sheep[1] having been demonstrated, we are now endeavouring to trace the mode and function of this response. One section of a series of experiments designed to cover this aspect involved the use of hormone-replacement therapy. This required the acceptance as a working hypothesis that the pituitary gland is stimulated by the photoperiodic treatment so as to increase the output of the various hormones known to be associated with it, resulting finally in an increased rate of wool-growth. The availability

of hormones restricted the number which could be used to three.

Ten mature Corriedale ewes were randomized on a live-weight basis into four groups. They were housed in four adjacent pens of the same shed, each pen containing a complete group. Exactly the same standard maintenance ration of concentrates and chaffed lucerne hay was fed daily to all groups throughout the experiment. This resulted in maintaining the body-weight of the control group fairly constant until shearing in mid-October, when, as would be expected, the weight of all groups fell by the weight of wool removed, that of the control group remaining constant thereafter.

The three hormones used were: (*a*) l-thyroxine injected subcutaneously as an aqueous solution totalling 92 mgm. per ewe over the period; (*b*) tri-iodo-thyronine injected subcutaneously as an aqueous solution totalling 30 mgm. per ewe over the period; (*c*) anterior lobe pituitary extract administered orally in pill form, totalling 92½ grains of desiccated substance over the period.

The method was to use a dose-level above the physiological range to some extent indicated by Maqsood's use of thyro-active iodinated casein[2], until definite biological activity had been established by a sharp loss of live weight amounting to about 8 lb. per ewe. The succeeding doses were then spaced so as not to bring about a further alteration in live weight during the period.

Every month the wool was clipped from similar areas of skin on each sheep, clean scoured and weighed dry. The dry weight of wool clipped from each ewe in any one month was then expressed as a ratio of the same ewe's monthly production from the same area of skin during the previous December–January–February period, when nutritional conditions were identical for all sheep. Thus for each ewe the wool-growth curve at its maximum[3], is used as a standard to which subsequent production can be related. The group means have been plotted in this manner in Fig. 1, which in addition shows the period when the hormones were administered relative to the responses obtained.

During the period, the increases in wool-growth obtained from the thyroxine and tri-iodo-thyronine groups are substantial and statistically significant. It will be further noted that cessation of the injections resulted in a return to the normal curve of the controls, with which wool-growth conformed thereafter.

The obvious failure of the anterior pituitary extract to produce any effect on wool-growth may be explainable in two ways: (*a*) it has not yet been possible to trace the source from which the extract was manufactured; if this was, as appears likely, ox pituitaries, then it could be possible for the sheep injected with this substance to produce an immunity, thus preventing any biological action taking place, or (*b*) the dose-level was not high enough to cover the inefficiencies of oral administration.

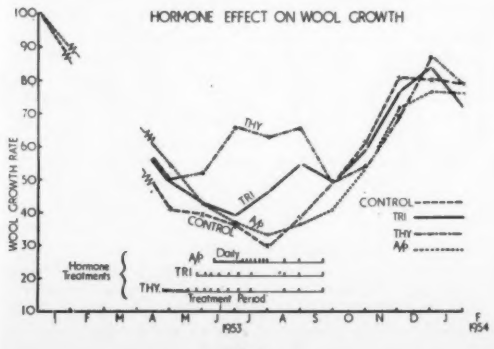

Fig. 1

These experiments are being continued and will be reported more fully elsewhere.

Thanks are due to the University of New Zealand for financial assistance and to Glaxo Laboratories, Ltd., for their active interest and co-operation in supplying the l-thyroxine and tri-iodo-thyronine used.

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[3] Coop, I. E., *J. Agric. Sci.*, 43, 456 (1953).

Sulphydryl Groups in Wool

A method for the estimation of sulphydryl groups in hair and other insoluble proteins by means of the specific sulphydryl reagent, 1-(4-chloromercuriphenylazo)-naphthol-2, has recently been reported by Scott and Flesch[1]. In this method, the hair is pulverized, treated with water at 100° or an aqueous solution of a swelling agent at 40° and shaken with a solution of the reagent in amyl acetate, the decrease in concentration of the reagent in the amyl acetate layer being measured colorimetrically.

A modification of this method is in use in this laboratory to detect and estimate sulphydryl groups in wool. The colour reagent is dissolved in formamide, which swells the fibres sufficiently to allow penetration and thus avoids the necessity of grinding up the wool. Sulphydryl groups may therefore be detected by the orange colour of the fibres after washing out excess reagent, and an approximate measure of the concentration of these groups may be obtained by observing the decrease in intensity of colour of a standard solution of the reagent in contact with a known amount of wool. In practice, a sample of 50 mgm. of wool of known moisture content is shaken mechanically at 30° with an appropriate volume of a formamide solution of the reagent containing 4 mgm. per 100 c.c. The rate of reaction is rapid at first, but slows down considerably until after four days it has reached a small, although finite, value. The figures quoted below refer to a reaction time of four days and thus probably represent minimal values. All the untreated wool samples tested so far have become an orange colour, indicating that they contain sulphydryl groups, although samples pretreated with a mercuric chloride solution to block sulphydryl groups do not absorb the reagent.

To standardize the colour reagent, an amyl acetate solution was allowed to react with a known amount of glutathione[2,3]. The solution in formamide could not be used because the coloured derivative of glutathione is soluble in this solvent.

It has been found that, for a typical South African merino wool, the average concentration of sulphydryl groups is 7 micromoles per gm. of dry wool. There do not appear to be any reliable values for the concentration of sulphydryl groups in wool that can be used for comparison (see Park and Speakman[4]).

Fig. 1. Light-coloured root section at bottom

The distribution of sulphydryl groups in wool from copper-deficient sheep has been studied by this method. A number of sheep, after having been reared on copper-deficient pasture, were fed a diet adequately supplemented by copper sulphate, as in earlier experiments[5]. Samples of wool were thus available from these sheep with an easily recognizable 'copper-deficient' section and a 'normal' section near the root. Fig. 1 shows such a staple of merino wool after purifying and treating with a formamide solution of the colour reagent for three days. The 'copper-deficient' section has an intense orange colour which tends to decrease towards the tip, possibly owing to the effect of weathering on the sulphydryl groups, and a clear line of demarcation separates this section from the 'normal' section, which has a faint orange colour. The rather short length of the 'normal' section in Fig. 1 was due to felting of this section in formamide.

The average concentration of sulphydryl groups was found to be 26 micromoles per gm. in 'copper-deficient' wool, excluding the damaged tips, and 10 micromoles per gm. in 'normal' wool from the same staple. It is known from the nitroprusside test for sulphydryl groups that the region of intense staining in the wool follicle is of a much greater length in copper-deficient sheep than in normal sheep, although this test gives a barely perceptible colour for 'copper-deficient' wool that has emerged from the follicle[6]. It now appears that the conversion of sulphydryl groups to cystine linkages is less complete in 'copper-deficient' than in 'normal' wool, and this may help to explain the relative weakness of this wool (cf. the results of Palmer[6] on wool hydrolysates).

Experiments aimed at increasing the rate and degree of penetration of the colour reagent into wool fibres are now in progress. It has been found that penetration is complete in a few hours if the fibres are first supercontracted in hot aqueous phenol[7]. In this case, however, about twice as many sulphydryl groups are detected, the origin of which is under investigation.

I wish to thank Dr. P. C. Carman for advice in this work, and the South African Wool Board for a fellowship. This communication is published with the permission of the South African Council for Scientific and Industrial Research.

R. W. Burley

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South African Council for
Scientific and Industrial Research,
Pretoria.

[1] *Science*, **119**, 70 (1954).
[2] Flesch and Kun, *Proc. Soc. Exp. Biol. Med.*, **74**, 249 (1950).
[3] Private communication from Dr. P. Flesch.
[4] *Bull. Inst. Text. France*, **30**, 255 (1952).
[5] Marston, "Fibrous Proteins", 211 (Society of Dyers and Colourists, Bradford, 1946).
[6] Palmer, R. C., *J. Agric. Sci.*, **39**, 265 (1949).
[7] Zahn, *Kolloid-Z.*, **113**, 157 (1949).

Pelvic Relaxation in Sheep

Pelvic relaxation in pregnant females has been studied for several species of small animals and for primates[1]. Experimental investigations on the hormonal control of this process in mice and guinea pigs are encountered frequently in the current literature. Less attention has been given to this aspect of reproductive physiology in farm animals. Work is at present in progress at Ruakura on pelvic relaxation in sheep. Study of the factors involved are important in the understanding of parturition problems such as dystocia and vaginal prolapse.

To obtain a clear picture of the physical changes which take place in the pelvic region of the pregnant ewe, sixty animals have been slaughtered. Dissected ewes were examined at monthly intervals during gestation and after parturition. Physical methods were devised to measure objectively changes in the joints and appropriate soft tissues. In these ewes there was no relaxation in the pubic symphysis at any stage. Loosening of the sacro-iliac joints and of the sacro-sciatic ligaments began between the second and third months, reaching a maximum value at, or immediately after, parturition. Regression of these joint changes was incomplete in some cases even three months after lambing. For a total of twenty-five non-pregnant ewes killed just before the breeding season, movement of the sacro-iliac joints was barely perceptible. No loosening of these joints was found in œstrous ewes. It was also found that the sacro-lumbar joint became more flexible with advancing pregnancy. Soft tissues such as those attaching the reproductive tract to the birth canal, and the muscles and ligaments of the perineum, also progressively become 'relaxed', though regression after parturition was much more rapid than in the case of the bone changes. Ewes with vaginal prolapse were generally more relaxed than normal ewes at the same stage of gestation, both in the sacro-iliac joints and soft tissues.

The dissected pelves of two full-term cows and one sow showed relaxation only of the sacro-iliac joints.

In a preliminary experiment on the hormonal control of pelvic relaxation in sheep, four spayed ewes (spayed two years previously) were injected with 10 mgm. of diethylstilbœstrol daily for five days. Two of these ewes were then injected, on the sixth day, with 650 G.P.U. of 'Releasin' (relaxin) (kindly supplied by Dr. Robert L. Kroc, Warner Chilcott Research Laboratories, Morris Plains, New Jersey). All animals, including one untreated spayed ewe, were killed and dissected twenty-four hours later, on the seventh day. In the four treated ewes quite marked loosening of the sacro-iliac joints and the sacro-sciatic ligaments occurred, equivalent to that found in ewes four months in lamb. The joints of the relaxin-treated ewes were no looser than those injected with stilbœstrol alone. No measurable changes took place in the soft tissues.

Investigations have shown that œstrogen and androgen can first be detected in the urine between the twelfth and fifteenth weeks of gestation[2], providing indirect evidence that hormones are closely involved in pelvic relaxation in the ewe.

In the experiment on spayed ewes described above, loosening of the sacro-iliac joints was caused by œstrogenic stimulation alone. However, further work is necessary to study the role of the relaxin hormone. Preliminary experiments have shown that a sub-

stance with relaxin-like activity is present in pregnant ewes' ovaries, and in very low concentrations in the blood serum. Interaction of œstrogen and relaxin may be necessary to effect marked changes in soft tissues at different dose-levels than those used here.

The mode of action of relaxin appears to vary markedly between different species. There is room for extensive study of the comparative physiology of this hormone.

E. G. Bassett
D. S. M. Phillips

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Department of Agriculture,
Hamilton, N.Z.
July 16.

[1] Hisaw, F. L., and Zarrow, M. X., "Vitamins and Hormones", 8, 151 (Academic Press, Inc., N.Y., 1950).
[2] Bassett, E. G., Sewell, O. K., and White, E. P. (in the press).

Tolerance to the Maize Rust *Puccinia polysora* Underw.

The maize rust disease *Puccinia polysora* Underw was observed in Nyasaland again in the 1953–54 growing season, its first appearance in the country having been in the 1952–53 season. At the Agricultural Research Station, Lilongwe, a replicated trial was carried out in which the use of a fungicide spray 'Blitane' (zinc ethylene *bis* dithiocarbamate) reduced the incidence of the fungus on the maize on sprayed plots as compared with those which were unsprayed. All plots were split into three varieties: (*a*) an imported hybrid; (*b*) a locally selected open-pollinated variety; (*c*) an unselected local native maize.

Scores were made for the number of open uredosori, the total possible for a severely infected plant being 9. Spraying did not prevent the incidence of the rust, but reduced the score for the sprayed plots by about one half as compared with those unsprayed. The unsprayed hybrid was given an average score of 3·5 per plant, and those of the local selected and unselected maize were 1·9 and 1·6 respectively. However, the yield of the hybrid was reduced by 17 per cent, whereas that of the local varieties was completely unaffected. Thus there are clear indications of differences in varietal susceptibility and of tolerance, although all three types have given the fully susceptible reaction to the method of testing for juvenile resistance in the greenhouse.

The tolerance of the local varieties—which yielded much less than the hybrid even when the latter was fully attacked by the rust—may be an indication that they do not express in the yield of their grain the full capabilities of their metabolism. This would allow for a reservoir which absorbs the inroads of disease, and until it is exhausted no loss in yield would be encountered. Native maize of this same type has been inbred, and hybrids produced, which will be grown here next season. If the foregoing hypothesis is correct, it may be expected that these, being more highly selected and yielding more nearly to their true capacity, will suffer greater loss in yield from the presence of the disease.

R. T. Ellis

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Nyasaland.
July 30.

A Method of rearing Individual Trombiculid Mites in the Field

The taxonomy of the Acarina Trombiculidae requires stabilizing by the study of the non-parasitic post-larval stages. Fewer than sixty nymphs and adults are known out of more than five hundred species, and of these only very few can be identified with absolute certainty. Techniques for rearing nymphs from engorged larvæ are widely known and practised, but a single host often carries several or many species of chiggers, and taxonomic studies make it necessary to identify each nymph by reference to the cast larval pelt. Although this is practicable in the laboratory, it is extremely difficult to do in the field especially when moving from place to place, because nymphs may take several weeks to emerge.

The following simple method was designed to allow the rearing of identifiable nymphs from chiggers collected during expeditions in Borneo and Malaya. It has also been used for rearing nymphs of related families of mites. It is worth noting that the larval pelts obtained are frequently complete except for disarrangement and some loss of body setæ; and because they show no deterioration with age after mounting they are often of more permanent value than mounts of actual larvæ themselves.

Collection of engorged larvæ. Techniques must be modified for every occasion to suit local conditions and requirements, such as the need to preserve skins of hosts intact. It is economical to allow chiggers to become detached naturally rather than to pick them off individually. Scrapings, or better, fragments of infested skin, are placed in water in cavity blocks, or are pinned to the corks of 2 in. × 1 in. tubes, and left overnight for larvæ to become detached. Engorged larvæ are then selected for rearing. Full engorgement is not always necessary to allow development of the nymph. If time and space allow (for example, in the laboratory), chiggers may be placed on water in cavity blocks or Syracuse dishes and the emergence of nymphs awaited—the nymph usually sinks while the larval pelt remains floating.

Rearing in tubes. Use stout round-bottomed tubes, or simple lengths of tubing corked at both ends, and soft rubber corks; a good size is about 35 mm. × 8 mm. Cut cigarette paper into strips to fit the tubes, say, 25 mm. × 6 mm. When planting larvæ, mark a small circle in pencil near one end of a strip, at the same time entering identification data and date. Place in a tube with the circle near the mouth and wet thoroughly. Plant a selected larva in the marked circle: it is usually held there by surface tension, and the optimum degree of wetness is soon learnt by experience. Flooding will allow the larva to move within the water film; if the size of the paper and the amount of water added is too small in relation to the volume of the tube, the paper will tend to dry out and the larva be released. Most papers have too rough a surface and hold too thick a film of water to be suitable. If conditions of work allow, it is better to allow batches of larvæ to remain floating in water in cavity blocks for a few days and then to plant out the larvæ which become akinetic. The corked tubes are inspected at intervals. When a nymph has emerged, it should be preserved in 50 per cent spirit together with identification data. The larval pelt is usually left stuck down by the water film in the circle on the paper slip; it can be floated off gently at leisure and mounted. It can nearly always be identified without trouble, but it helps to

have mounted a batch of larvæ from the same host. If fungal growth proves troublesome, it may be kept down by a trace of merthiolate. This is preferably introduced after the larva has become akinetic. It, or a trace of formalin or spirit, may be introduced as a routine to the tube after removing the nymph if the larval pelts are to be kept indefinitely awaiting an opportunity to mount and study them. The comments of other workers who use this technique would be greatly appreciated.

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Malaya.
Oct. 13.

Presence of a Peritrophic Membrane in Diplopods

The presence of a peritrophic membrane has been reported in the midgut of the following classes of mandibulate Arthropoda: Onycophora, Crustacea, Insecta and Chilopoda[1]. It has not been reported in the Diplopoda, although Randow[2] stated that the brush border of the midgut epithelial cells may slough off. We have dissected tubular membranes giving a positive chitosan reaction[3] from the midguts of the following British millipedes: *Tachypodoiulus niger*, *Ophyiulus pilosus*, *Iulus scandinavius*, *Cylindroiulus punctatus* (Iulidae), *Glomeris marginata* (Glomeridae), *Polydesmus angustus* (Polydesmidae), *Polymicrodon polydesmoides* (Craspedosomidae) and *Choneiulus palmatus* (Blaniulidae). The presence of a similar membrane has been inferred from paraffin sections of the midgut of *Polyxenus lagurus* (Polyxenidae). In none of these is there an œsophageal valve; it is therefore inferred that the peritrophic membrane arises by delamination of the brush border from the midgut epithelial cells. A delaminating brush border has been observed in *O. pilosus*, *C. punctatus*, *G. marginata*, *P. polydesmoides* and *C. palmatus*. Furthermore, in *G. marginata*, *P. angustus*, *T. niger*, *I. scandinavius*, *C. punctatus* and *P. polydesmoides* concentric peritrophic membranes were seen in sections, a phenomenon often observed when membranes are formed by delamination[4].

We wish to thank Mr. J. G. Blower for his help with identifications.

Betty Mason
Owen Gilbert

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Nature Conservancy,
Grange-over-Sands, Lancashire.
Aug. 27.

[1] Waterhouse, D. F., *Nature*, **172**, 676 (1953).
[2] Randow, E., *Z. wiss. Zool.*, **122**, 534 (1924).
[3] Campbell, F. L., *Ann. Ent. Soc. Amer.*, **22**, 401 (1929).
[4] Wigglesworth, V. B., "The Principles of Insect Physiology" (Methuen, London, 1950).

Acceleration of Flowering in Non-vernalized Chrysanthemums by the Removal of Apical Sections of the Stem

Vince and Mason[1] have reported recently that unvernalized plants of *Chrysanthemum morifolium* var. Sunbeam can be induced to produce flowering lateral shoots by decapitation of the main shoot. Under the stated conditions the main apex did not bud for a further four to six weeks. They suggest that inhibitory effects from the main apex are responsible for the failure of unvernalized plants to bud.

However, in variety Sunbeam it is in fact quite unnecessary for the main apex to be removed in order to obtain budded laterals. This observation was briefly mentioned in the paper referred to by Vince and Mason[2].

Flowering laterals in the presence of a vegetative main apex frequently appear on plants that have received a slight degree of vernalization. In a recent experiment, four out of four slightly vernalized plants, and twelve out of twenty-four incompletely devernalized plants which failed to bud with their main apices, produced flowering lateral shoots. The entirely unvernalized controls remained vegetative at lateral as well as main apices. A photograph of such plants accompanies a manuscript awaiting publication in the *Journal of Experimental Botany* dealing with the de-vernalization of the chrysanthemum.

As regards the theoretical interpretation of Vince and Mason's results, it may be mentioned that no evidence has been found for translocation of either positive or negative effects in grafting experiments between vernalized and unvernalized partners[3].

W. W. Schwabe

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London, S.W.7.
Nov. 4.

[1] Vince, D., and Mason, D. T., *Nature*, **174**, 842 (1954).
[2] Schwabe, W. W., *J. Exp. Bot.*, **1**, 329 (1950).
[3] Schwabe, W. W., *J. Exp. Bot.* (in the press).

Zoological Nomenclature

Notice is hereby given that, as from April 22, 1955, the International Commission on Zoological Nomenclature will start to vote on the following cases involving the possible use of its plenary powers for the purpose specified against each entry. (1) Renier [1804] *Prospetto*; question of validation of four generic names (*Discoides*; *Cerebratulus*; *Polycitor*; *Scolizedon*) published in; (2) Renier [1807] *Tavola*; question of validation of six generic names (*Aglaja*; *Alcyonaria*; *Cystia*; *Rodens*; *Tuba*; *Tubulanus*) published in; (3) names (generic and specific) given to aptychi of Ammonites, suppression of; (4) *Notropis* Rafinesque, 1818 (Cl. Osteichthyes), determination of gender as masculine; (5) *Cheloniceras* Hyatt, 1903 (Cl. Cephalopoda, Order Ammonoidea), designation of type species for; (6) *Argus* Bohadsch, 1761 (Cl. Gastropoda), retention of status for the purposes of the law of homonymy, to preserve *Lysandra* Hemming, 1933, from falling as a synonym of *Argus* Boisduval, 1832; (7) *minimus* Miller (J. S.), 1826 (*Belemnites*) (Cl. Cephalopoda, Order Dibranchia), validation of. A proposal for a 'Declaration' banning names based on aptychi of ammonites is also being made.

Full particulars of these cases appear in Part 9 of Volume 9 of the *Bulletin of Zoological Nomenclature*.

Comments on the above cases should be sent to me as soon as possible.

Francis Hemming
(Secretary)

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London, N.W.1.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, November 29

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE (in the Lecture Theatre of the Science Museum, South Kensington, London, S.W.7), at 5.30 p.m.—Dr. G. J. Whitrow: "Ancient and Mediaeval Hindu Mathematics and Astronomy".

Tuesday, November 30

UNIVERSITY COLLEGE, LONDON (in the Anatomy Theatre, Gower Street, London, W.C.1), at 1.15 p.m.—Dr. B. A. Rowley: "Psychology and Literary Criticism".*

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. A. D. Holland: "Prestressed Units for Short-Span Highway Bridges".

ROYAL INSTITUTE OF CHEMISTRY, LONDON SECTION (joint meeting with the SIR JOHN CASS COLLEGE CHEMICAL SOCIETY, at Sir John Cass College, Jewry Street, London, E.C.3), at 6.30 p.m.—Dr. M. A. Phillips: "Synthetic Organic Chemicals in Agriculture".

SOCIETY FOR ANALYTICAL CHEMISTRY, PHYSICAL METHODS GROUP (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Tenth Annual General Meeting, followed by a discussion on "Possibilities in the Establishment of Standard Samples for the Determination of Some Trace Elements".

Wednesday, December 1

UNIVERSITY OF LONDON (at the Postgraduate Medical School of London, Ducane Road, London, W.12), at 2 p.m.—Prof. J. N. Davidson: "Recent Developments in the Biochemistry of the Nucleic Acids".

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Mr. J. N. Dean: "The Insulation of Submarine Telephone Cable" (Llewelyn B. Atkinson Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, London, W.C.2), at 5.30 p.m.—Mr. H. Page and Mr. G. D. Monteath: "The Vertical Radiation Patterns of Medium-Wave Broadcasting Aerials".

SOCIETY FOR ANALYTICAL CHEMISTRY (joint meeting with the OILS AND FATS GROUP of the SOCIETY OF CHEMICAL INDUSTRY, at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Meeting on "Methods for the Chemical Determination of Vitamin A".

SOCIETY OF VISITING SCIENTISTS LIMITED (at 5 Old Burlington Street, London, W.1), at 7.30 p.m.—Discussion Meeting on "Recent Research on Speech". Chairman: Sir Archibald Gill; Speakers: Dr. D. B. Fry, Dr. E. C. Cherry and Prof. R. C. Oldfield.

Wednesday, December 1—Thursday, December 2

IRON AND STEEL INSTITUTE (in association with the INSTITUTE OF METALS, at Church House, Westminster, London, S.W.1)—Symposium on "Powder Metallurgy".

Wednesday, December 1

At 9.45 a.m.—Discussion on Papers in Group 1: "Manufacture, Properties and Testing of Powders".

At 2.15 p.m.—Discussion on Papers in Group 2: "Principles and Control of Compacting and Sintering".

Thursday, December 2

At 9.30 a.m.—Discussion on Papers in Group 3: "Manufacture and Properties of Structural Engineering Components".

At 2 p.m. Discussion on Papers in Group 4: "Powder Metallurgy of High-Melting-Point Materials".

Thursday, December 2

UNIVERSITY COLLEGE, LONDON (in the Anatomy Theatre, Gower Street, London, W.C.1), at 1.15 p.m.—Mr. A. J. Arkell: "The Magical Statuettes of Ancient Egypt".*

ROYAL SOCIETY OF ARTS, COMMONWEALTH SECTION (at John Adam Street, Adelphi, London, W.C.2), at 5.15 p.m.—Mr. J. Grenfell Williams: "Broadcasting in the Colonies".

UNIVERSITY OF LONDON, BRITISH POSTGRADUATE MEDICAL FEDERATION (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.30 p.m.—Dr. Rosalind Pitt-Rivers: "Thyroid Hormones". (From a series of lectures on "The Scientific Basis of Medicine".)*

SOCIETY OF CHEMICAL INDUSTRY, ROAD AND BUILDING MATERIALS GROUP (in the Lecture Hall of the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6 p.m.—Mr. D. C. Broome: "The Physico-Chemical Properties of Bitumens as used in Mastic Asphalt".

INSTITUTE OF METALS (joint meeting with the CHEMICAL ENGINEERING GROUP of the SOCIETY OF CHEMICAL INDUSTRY, at the University Chemical Department, Woodland Road, Bristol), at 6.30 p.m.—Dr. A. R. Harding: "Thermochemistry of Alloys".

INSTITUTE OF PHYSICS AND THE CHEMICAL SOCIETY (joint meeting of the MANCHESTER BRANCHES, in the Chemistry Lecture Theatre, The University, Manchester), at 6.30 p.m.—Prof. P. J. Flory (Cornell University): "The Configuration and Properties of Polymer Molecules in Dilute Solution".

BRITISH GLACIOLOGICAL SOCIETY (at Bedford College, Regent's Park, London, N.W.1), at 7.30 p.m.—Mr. H. Lister: "The Glaciological Work of the British North Greenland Expedition".

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 7.30 p.m.—Scientific Papers.

Friday, December 3

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE, PHILOSOPHY OF SCIENCE GROUP—NORTHERN BRANCH (in Staff House, The University, Manchester), at 7 p.m.—Dr. W. H. Thorpe, F.R.S.: "The Study of Animal Behaviour and Some of its Implications".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Sir Christopher Hinton, F.R.S.: "Industrial Power from Nuclear Energy".

Saturday, December 4

LONDON COUNTY COUNCIL (at the Horniman Museum, London Road, Forest Hill, London, S.E.23), at 3.30 p.m.—Mr. Eric Simms: "A Study in Sound of Some Highland Birds".*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER OR ASSISTANT LECTURER IN CLINICAL PARASITOLOGY in the Veterinary School—The Registrar and Secretary, The University, Bristol (November 30).

ASSISTANT EXPERIMENTAL OFFICER to work in the BEE DEPARTMENT on bee behaviour—The Secretary, Rothamsted Experimental Station, Harpenden, Herts (December 1).

RESEARCH ASSISTANT IN THE DEPARTMENT OF PHYSICS, for duties which will involve general assistance in radio research investigation—The Registrar, University College, Singleton Park, Swansea (December 1).

GENERAL ASSISTANT ENGINEERS (2), (with a university degree or equivalent qualifications in electrical engineering or in physics) at the Research Laboratories, British Electricity Authority, Leatherhead, for duties which include research on electrostatic precipitation and allied problems—The Director of Establishments, British Electricity Authority, Winsley Street, London, W.1, quoting NAT/541 (December 3).

PATHOLOGIST (with veterinary or medical qualifications) AT THE POULTRY RESEARCH CENTRE, Edinburgh, to develop a programme of original research using the fowl as experimental material—The Secretary, Agricultural Research Council, Cunard Building, 15 Regent Street, London, S.W.1 (December 3).

BIOCHEMIST, basic grade (with a B.Sc. degree with honours in biochemistry or chemistry, or equivalent qualification)—The House Governor, The General Hospital, Birmingham 4 (December 4).

HEAD (with a good honours degree, teaching and industrial experience, and preferably with research experience) OF THE ENGINEERING DEPARTMENT—The Principal, Kingston Technical College, Fassett Road, Kingston-upon-Thames (December 4).

PRINCIPAL (with a degree in agriculture and sound practical farming knowledge, experience of teaching and administrative ability) OF THE BROOKSBY HALL FARM INSTITUTE—The Director of Education, County Offices, Grey Friars, Leicester (December 4).

RESEARCH STUDENT (graduate in physics or electrical engineering) IN PHYSICS—The Registrar, The University, Sheffield (December 6).

SCIENTIFIC OFFICER (honours graduate) to carry out ecological and population studies of soil pests as affected by insecticides—The Secretary, National Vegetable Research Station, Wellesbourne, Warwick (December 8).

LECTURER OR SENIOR LECTURER (with an appropriate honours degree and preferably with teaching experience) IN MATHEMATICS, AND PHYSICS AND MECHANICS, at the R.N. College, Dartmouth—The Secretary, Civil Service Commission 6 Burlington Gardens, London, W.1, quoting 4397/54 (December 10).

PHYSICIST (with H.S.C. (science) or equivalent) in the Ministry of Supply, to assist in environmental physiological research in Nigeria—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A.325/54A (December 11).

PROFESSOR (with high academic qualifications and practical works experience in ferrous metallurgy) OF CHEMISTRY AND METALLURGY, at the Royal Naval College, Greenwich, London, S.E.10—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting 4395/54 (December 14).

ASSISTANT (graduate in science, preferably biochemistry or organic chemistry, and with research and literary experience) TO THE CHAIRMAN OF THE EDITORIAL BOARD—Dr. A. Neuberger, F.R.S., *Biochemical Journal*, National Institute for Medical Research, The Ridgeway, Mill Hill, London, N.W.7 (December 18).

RESEARCH OFFICER (Bacteriologist) (with an honours degree in science or agricultural science with bacteriology, chemistry or biochemistry as a major subject, and with postgraduate research experience) IN THE DIVISION OF FOOD PRESERVATION AND TRANSPORT, Commonwealth Scientific and Industrial Research Organization, Homebush, N.S.W., Australia, for investigations in the field of microbial physiology; initially studying the effects of freeze-drying—The Chief Scientific Liaison Officer, Australian Scientific Liaison Office, Africa House, Kingsway, London, W.C.2, quoting 300/150 (December 18).

SENIOR RESEARCH FELLOW (with experience in wind-tunnel work) IN THE DEPARTMENT OF AERONAUTICAL ENGINEERING, to design new high-speed laboratory equipment and take a leading part in the research work of the Department—The Secretary and Registrar, The University, Southampton (December 31).

CHAIR OF PHARMACEUTICAL CHEMISTRY—The Registrar, The University, Nottingham (January 8).

CHAIR OF PHYSICAL METALLURGY—The Registrar, The University, Sheffield 10 (January 8).

I.C.I. RESEARCH FELLOWSHIPS IN BIOCHEMISTRY, CHEMISTRY, ENGINEERING, PHARMACOLOGY or PHYSICS—The Secretary of University Court, The University, Glasgow (February 26).

ASSISTANT, Grade B (graduate of a British university, and with good teaching and/or industrial experience) to teach chemistry in relation to the cocoa, chocolate and sugar confectionery industry; and an ASSISTANT, Grade B (graduate of a British university, and with good teaching and/or industrial experience) to teach biology up to general certificate of education advanced level—The Principal, Borough Polytechnic, Borough Road, London, S.E.1.

ASSISTANT (Scientific) IN THE METROPOLITAN POLICE LABORATORY—The Secretary, Room 139, New Scotland Yard, London, S.W.1.

BIOCHEMIST, CHEMIST or PHYSICIST (interested in research in biophysics), to join a small team studying the structure of plant viruses—The Secretary, Birkbeck College, Malet Street, London, W.C.1.

CHEMIST (with considerable experience in the analysis of biological materials, and, in particular, the use of modern techniques, and able to assist in equipping and organizing a new laboratory unit) to take charge of the Analytical Department—The Secretary, Grassland Research Institute, Hurley, near Maidenhead, Berks.

ELECTRICAL ENGINEER/PHYSICIST, Senior Experimental Officer grade (with at least H.S.C. (science) and preferably with a good basic understanding of electronics and practical experience of the generation of high voltage pulses and the measurement of very short time intervals) at Fort Halstead, Kent, to assist in research and development on problems associated with high voltage, high energy electrical discharges—The Senior Recruitment Officer, Atomic Weapons Research Establishment, Aldermaston, Berks, quoting 299/WGE/2.

ENTOMOLOGIST, PLANT BREEDERS (2), and a SOIL CHEMIST (with an appropriate honours degree, and fully literate in either Arabic or English) in the Research Division of the Ministry of Agriculture, Sudan Government—The Sudan Agent, Sudan House, Cleveland Row, London, S.W.1.

ENTOMOLOGIST, to develop a field technique to control biting midges—Dr. S. D. Kettle, Zoology Department, West Mains Road, Edinburgh 9.

EXPERIMENTAL OFFICERS (3) (with at least Higher School Certificate in science subjects or equivalent) IN THE NUCLEAR PHYSICS DIVISION for research in the study of nuclear transmutations—The Establishments Officer, United Kingdom Atomic Energy Authority, Research Group, Harwell, Didcot, Berkshire, quoting 2/103/181.

PHYSICIST/MECHANICAL ENGINEER, Scientific Officer grade (with a first- or second-class honours degree in physics or equivalent qualification) to undertake studies/research on the mechanical effects of stresses applied to atomic weapons (Ref. 109/WGE/2); and a PHYSICIST or METALLURGIST, Scientific Officer grade (with a first- or second-class honours degree in physics or metallurgy) to carry out fundamental and applied research on reactive inorganic compounds (Ref. 251/WGE/2)—The Senior Recruitment Officer, Atomic Weapons Research Establishment, Aldermaston, Berks, quoting appropriate Ref. No.

PRINCIPAL SCIENTIFIC OFFICER (with a first- or second-class honours degree or equivalent in physics, mechanical or electrical engineering, and with considerable research experience) IN THE ROCKET PROPULSION DEPARTMENT, R.A.E., Westcott, Bucks, to lead a small section engaged in research and rocket motor instrumentation—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A.321/54A.

RESEARCH OFFICER (with a first- or second-class honours degree in biology and at least two years postgraduate experience in animal genetics) IN THE EAST AFRICAN AGRICULTURE AND FORESTRY RESEARCH ORGANIZATION, for animal genetics studies in the Animal Industry Division—The Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, quoting BCD.195/151/01.

SCIENTIFIC OFFICER (with a first- or second-class honours degree in physics or equivalent qualification) for basic research into the mechanical properties of certain radioactive metals and alloys—Senior Recruitment Officer, Atomic Weapons Research Establishment, Aldermaston, Berks, quoting 272/WGE/2.

SCIENTIFIC OFFICER (with a first- or second-class honours degree in physics or mathematics, and an interest in applying mathematics to practical problems) to carry out theoretical work in connexion with the design of nuclear reactors—United Kingdom Atomic Energy Authority, Research Group, Harwell, Didcot, Berks.

SENIOR BIOCHEMIST (science graduate)—The Medical Superintendent, County Hospital, Stonehouse, Lanarkshire.

SENIOR SCIENTIFIC OFFICER or SCIENTIFIC OFFICER (with a first- or second-class honours degree in physics with subsidiary mathematics, and for the post of Senior Scientific Officer at least three years appropriate postgraduate research experience) at Fort Halstead, Kent, to undertake experimental small-scale work on fundamental problems in connexion with the study of phenomena associated with explosions—The Senior Recruitment Officer, Atomic Weapons Research Establishment, Aldermaston, Berks, quoting 209/WGE/2.

TECHNICIAN (preferably with experience in a pharmacological or physiological laboratory) IN THE DEPARTMENT OF PHARMACOLOGY—The Secretary, University College, Gower Street, London, W.C.1, quoting Pharmacology/5.

REPORTS and other PUBLICATIONS

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Privy Council. Medical Research Council Special Report Series No. 284: Intracranial Gliomata—Some Clinical, Radiological and Therapeutic Aspects of 298 Cases. By John Penman and Marion C. Smith. Pp. v+70. (London: H.M. Stationery Office, 1954.) 5*s*. net. [249

Report of the Technical Colleges and Industry Conference. (Organized by the F.B.I. Education Committee, and held at Ashorne Hill, Leamington Spa, Warwickshire, 5–7 May, 1954.) Pp. viii+88. (London: Federation of British Industries, 1954.) 4*s*. 6*d*. [249

Scottish Home Department. Marine Research, 1954—No. 2: The Food of the Whiting, and a comparison with that of the Haddock. By R. Jones. Pp. 34. (Edinburgh: H.M. Stationery Office, 1954.) 7*s*. net. [249

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Discours prononcés à la Manifestation d'Hommage à Victor van Straelen—Directeur de l'Institut Royal des Sciences Naturelles de Belgique, 1925–1954. Pp. 39. (Bruxelles: l'Institut Royal des Sciences Naturelles de Belgique, 1954.) [249

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